Robotics Badges: ***Programming Robots 2***

Programming Challenge

Use this handout for Step Five: Write a Program for a Robot in Programming Robots 2.

Activity Background: Engineers design complicated machines for big factories, but they also use their skills to create products for the home. Helen Greiner, one of the founders of the company iRobot, was working on an industrial-sized robotic vacuum, but it was so large and heavy that it could damage furniture or hurt people if anything went wrong. So the iRobot team decided to work out any problems by making a smaller prototype. The smaller model was so handy that the company began producing it as the Roomba robotic vacuum, which is now used in homes around the country

Challenge: Write simulated computer code that tells a robovac how to vacuum a room and return to its charging station. To help, you'll use a checkerboard as a map of the room to be vacuumed, black checkers as obstacles, and a red checker as the robovac to be moved around the room. Your goal is to write a program that will move the red checker around every square that is not covered by a black checker.

Writing a Computer Program: When you are writing a computer program, spelling and punctuation must be perfect. Otherwise, the computer won't understand what you are trying to say. However, when you are just trying to figure out the steps in your program and what order they should go in, it's OK to make up your own pseudocode. That means writing out the commands in everyday language.

Some examples of pseudocode that tell a robovac how to move around include:

- **FORWARD 3** = move ahead 3 squares
- **RIGHT** = turn and face right

CHALLENGE INSTRUCTIONS:

1. Set the board in front of you. Label one sticky note as the robot's charging station and place it on the board, along the "wall" of the room (edge of the board). Place the red checker (the "robovac") on the charging station square.
2. Label one sticky note as a stairway going down. Place the sticky note on one of the squares on the board, somewhere in the "room."
3. Place a few black checkers around the board as stationary obstacles—tables, chairs, sofa, bookcase, etc. Label them using the sticky notes.
4. If you are writing a program using sensors (see Want a Challenge? Program a Robot with Sensors), label one checker as a dog, cat, or other pet and place it on the board.
5. Write out a program for your robovac using pseudocode (plain language) by writing each command on a sticky note. Attach the sticky notes to a sheet of paper. Move the commands around as needed.

Tip: Good coders add comments to their program so that other people know what they have done. To tell the computer to skip anything written as a comment, mark it with a symbol, such as a slash (/).

Here is an example of code that includes comments:

FORWARD 3 /Tells robot to move ahead 3 squares

(continued)

6. Test out your code as you work using the pieces on the checkerboard. Debug your program, making adjustments as needed.
7. If there's time left when you are finished, switch directions with another group and test each other's programs. It's always helpful to get feedback from other people!

Want a Challenge? Add Sensors in Your Program

A robot is a machine that can Sense, Think, and Act. That means you can tell the robot to gather information about its environment using its sensors; decide whether the information meets certain conditions by using its brain; and take different actions depending on what it finds. To add challenge to the activity, have groups include instructions that include sensors in their programs.

Here are some tips for programming a robot with sensors:

- **Conditional statements** tell a robot to check whether a condition is true or false or equal to a certain amount. The robot can get that information from its sensors. Conditional statements usually include words like "IF" "UNTIL," or "WHILE." For example, to tell a lawn-mowing robot to turn around when it reaches the fence, you could write, "IF the fence is in front of you, THEN reverse direction."
- You can use shortcuts to avoid writing the same set of commands over and over. Instead, you can write a "mini-program" and tell the main program to run them over and over. One kind of shortcut is a **loop**. It can run as many times as you tell it to. For example, to run a loop 3 times, you can write REPEAT 3, then list the steps within the mini-program. Write a command like END LOOP to show where the robot should move on to the next command.
- **More tips for using loops:** To make a loop repeat as long as the robot is running, you can write REPEAT forever. A loop can also keep repeating until a certain condition is met. For instance, you can tell a robot to keep bouncing a ball in the driveway until it is dark out.
- Another kind of shortcut is called a **function**. It is also a mini-program, but you can drop it into different places in the program. Whenever you want to insert the function, you just call its name. For example, if you have a robot that makes ice cream sundaes with three different flavors of ice cream, you can create a function named SCOOP that tells the robot how to scoop out the ice cream out of a carton. Then you can just write SCOOP each time the robot moves on to a new flavor.

These are suggestions for sensors and conditions to add to the programs:

- **Your robovac has a proximity sensor** that tells it when there is an object in front of it. Use conditional statements to tell the robovac what to do (such as turn and go around the object.)
- **Your robovac has an edge sensor** that tells it if it is about to fall down the stairs. Tell your robot what to do if it starts to go over an edge so it doesn't fall down the stairs!
- **Your robovac has a "pet sensor."** What kind of sensor might be able to tell the difference between a piece of furniture and a living creature? Tell the robot what to do if it comes near a pet.