**Instructional Days:** 2-3

**Topic Description:** Evaluate robot body designs and create algorithms to control robot behavior.

**Objectives:**

Students will be able to:

* Evaluate how the design of a robot’s body affects its behavior.
* Create an algorithm to direct a human “robot” from one part of the room to another.

**Outline of the Lesson:**

* “Are we Robots” activity (15 minutes)
* Journal Entry (5 minutes)
* The effect of changing design (15 minutes)
* Student group work—Can a robot tie your shoes? (40 minutes)
* Student group work—Walk like a robot (35 minutes)

**Student Activities:**

* Participate in discussion of “Are we robots” activity.
* Complete journal entry.
* Discuss how changing the design of an item affects the item.
* Students work in pairs to try tying a shoe in several robot-esque situations including with closed   
  eyes, with tongue depressors, pliers, and with another person.
* Students work in small groups to direct a person to move along a path given a limited list of   
  commands.

**Teaching/Learning Strategies:**

* Revisit “Are we robots” activity. Go through the list of items, asking students to indicate if they thought each item was a robot or not. Occasionally, especially if there is disagreement, ask students to defend their answer.
* Journal Entry: What happens when you change the design of a robot?
* Have students share their responses
* Ask students, “If you could change the body of the printer (or another device in the room) what would you change? How would that affect other things like the behavior or function of the printer, price, cost to build, or popularity? Have students share their ideas.
* Explain that there are limits to what robots can do because robots are limited by their bodies. For example, it is difficult to create a robotic hand that can grasp small or delicate items—it would require many motors (simulating all the muscles in the hand) and many sensors to detect the item (simulating the neurons in the hand).
* Make sure each pair of students has a shoe that can be tied.
* Direct students to first try tying the shoe blindfolded or with eyes shut. Discuss how it went—Was it hard? What was hard about it? How was it like a robot tying the shoe?
* Direct students to tie the shoe with heavy gloves on. Discuss the experience. How was it like a robot tying the shoe? What made it hard?
* Direct students to tie the shoe with tongue depressors taped onto thumbs and forefingers or just holding tongue depressors. Discuss the experience. How was it like a robot tying the shoe? What made it hard?
* Direct students to tie the shoe with pliers. How was it like a robot tying the shoe? What made it hard?
* Direct the students to work with their partner to tie the shoes using the pliers, each person holding one pair. Discuss the experience. How was it like two robots working together? What made it hard?
* Activity: Walk like a robot
* Choose one student to be a “robot” or tell students that you will be the robot. Choose a starting point and an ending point between which the “robot” must navigate. Make sure the path is not direct.
* Tell the class that they must direct the robot from the starting point to the ending point using only five commands:
* Turn left 90 deg.
* Turn right 90 deg.
* Take a step forward with the left foot.
* Take a step forward with the right foot.
* Stop.
* Students can take turns or work as a group. The robot should only follow those five commands and not respond to other commands. Tell students to be careful with the robot and not walk it into walls or barriers. (The robot should stop before it hits a barrier such as a wall.).
* At some point, remind students about loops. They can tell the robot to repeat a command or a block of commands such as “repeat: take a step forward with the left foot, take a step forward with the right foot until you are at the wall”
* Point out that this is frequently what is done in dancing and choreography—sequences of steps are repeated.
* If there is time, show the video of the “macarena” referenced in the resource section.
* Conclude by pointing out that these kinds of commands are what they will be programming their robots to execute.

**Resources:**

* Activity: Can a robot tie your shoes? (From <https://www.thetech.org/exhibits/online/robotics/activities/page05.html> )
* Materials: shoes that tie, tongue depressors, masking tape, heavy gloves, pairs of pliers, blind   
  folds
* Walk like a robot activity from LEGO Materials.
* http://www.cs.colorado.edu/~lizb/chaotic-dance/macarena-orig.mpeg.gz
* Explanation of video: http://www.cs.colorado.edu/~lizb/chaotic-dance.html