WORKSHEET (one per team)

Movement and Manipulators

Background Knowledge: 5 Basic Parts of a Robot

Robots can seem very complex, but all those bits and pieces can be divided into five main categories:

- Controller
- Power supply
- Movement
- Manipulators
- Sensors

The controller is the robot's brain, and the micro:bit microcontroller is the brain for the micro:bot. A battery pack functions as the robot's power supply.

This challenge focuses on movement and manipulators. Our micro:bots will all move using motors and wheels. Your team will need to adjust the code to make sure your robot goes straight and fast enough to beat the other robots to the targets.

The manipulator for this robot will be an arm. Your team will need to design and build an arm to lift, capture, and return the pegs to your base. The arm must be light-weight enough to be moved by a standard servo motor. The arm must be made of the materials provided in the classroom. The arm should not be permanently attached to the servo or the robot, and the arm must not intentionally interfere with the other team's arm or robot.

Make a note of the criteria and constraints for the robot arm.

Criteria What the arm must do	
Constraints What limits you have on your design	

Movement Testing

Robot motors usually don't all move at the same speed. One of your motors will move slightly faster than the other. Usually this difference is so slight you can't see it, but you will see you robot veer to the left or the right.

In order to make your robot drive straight, you'll need to change the speed of one or both motors and test the results. For example, if your robot veers off to the left, you'll need to increase the speed of the left motor or reduce the speed of the right motor. Test! Test! Test!

Change things a little bit and test the results, then change and test again. This is called *iterative testing*. It's an important part of engineering. Keep track of your changes and results as you test. Record the motor power settings in your program and the results in the chart below.

Left motor speed	**Right motor speed**	**Result (straight, goes left, goes right)**

Manipulator Design

Our robot arm is a 3rd class lever. This means that it bends like your elbow, pivoting from a point at one end and lifting something at the other end. The servo motor is located at the *fulcrum*, or pivot point. The peg the arm lifts is the *load*.

Use a separate piece of paper to brainstorm your robot arm design. How long will it be? How many "fingers" do you plan to put on your robot arm? You will need to test and adjust your design as you learn things about how the arm behaves. Testing and improvement can continue even between competition rounds! It can help to make your arm removable so that you can change our different arms for testing.