This worksheet is to be used with the Robotic Test Bed, and should not be attempted before completion of the first transmitter lesson.

Servos vs. Motors

1. The wheel assemblies should be plugged into motor ports 2 and 3.
2. Build two more wheel assemblies, using servo modules rather than motor modules. Building instructions can be found within the "Test the Kit" link under "Overview."
3. Plug one of the servo assemblies into motor port 1, and plug the other into motor port 4.
4. Control the first servo assembly by moving the right joystick along the horizontal axis. Record your observations.

   _____
5. Test the remaining three assemblies individually. Record your observations for each one.

   _____
6. Compare the response of the motor assemblies to that of the servo assemblies.

   _____
7. If you were building a car-like robot, would you attach the wheels to motor modules or servo modules?

   _____
8. Name a task that would be best suited for motor modules.

   _____
9. Name a task that would be best suited for servo modules.

   _____

Working with Jumpers

Activating Autonomous Mode

Jumpers can be used to enable several programs built into the Vex controller. The choice of port for the jumper determines which code will be enabled.

10. Remove the servo wheel assemblies. The two motor assemblies should still be plugged into motor ports 2 and 3.
11. Place a jumper clip on Analog/Digital port 13 to enable Autonomous Mode operation.
12. Gather two bumper switches and plug them into Analog/Digital ports 11 and 12.
13. Turn the Vex Controller on and, without touching the bumper sensors, record the test bed's response (including direction of rotation.) Turn the controller off when you are done.
14. Approximately how much time elapses between the time the Vex controller is turned on and the time that the wheel assemblies begin moving?

    _____
15. How could this time delay be useful if these wheel assemblies were part of a full robot?

_____

16. Turn the controller on again, and begin testing the function of the bumper sensors.
17. List the action, including direction of rotation, of both wheel assemblies under the following three conditions: no bumper sensors depressed, only bumper 11 depressed, only bumper 12 depressed.

No Bumper Depressed
Motor 2:
Motor 3:

Only Bumper 11 Depressed
Motor 2:
Motor 3:

Only Bumper 12 Depressed
Motor 2:
Motor 3:

18. Does wheel assembly 2 spin in the same direction when no bumper sensor is depressed as it does when Bumper 11 is depressed?
    _____
19. Does wheel assembly 3 spin in the same direction when no bumper sensor is depressed as it does when Bumper 12 is depressed?
    _____
20. This program was designed for a robot with the following set up:
    Motor 2 causes the right wheels to go forward when spinning counter-clockwise.
    Motor 3 causes the left wheels to go forward when spinning clockwise.
    Bumper 11 is on the left front of the robot.
    Bumper 12 is on the right front of the robot.
    Given this information, fill out the following table:

No Bumper Depressed

Wheel	Direction of Wheel	Action of Entire Robot (drives straight, turns left, etc.)
Left	_____	_____
Right	_____	_____

Only Left Bumper (#11) Depressed

Wheel	Direction of Wheel	Action of Entire Robot (drives straight, turns left, etc.)
Left	_____	_____
Right	_____	_____

Only Right Bumper (#12) Depressed

Wheel	Direction of Wheel	Action of Entire Robot (drives straight, turns left, etc.)

Left _____ _____
Right _____ _____

21. Turn on the transmitter while the test bed is running. Can you control the wheel assemblies with the transmitter?
    _____

Four Wheel Drive in 23 Mode

22. You will need 4 wheel assemblies that use motor modules in this exercise. If you are running low on parts, you can take apart the servo assemblies, since we will not be using them in this exercise.
23. Plug the wheel assemblies into motor ports 2, 3, 7, and 8.
24. Place a jumper clip on Analog/Digital port 15 to enable Four Wheel Drive in 23 Mode.
25. Make sure that the transmitter is set to Drive Mode 23.
26. List the action, including direction of rotation, of the four wheel assemblies under the following conditions:

Right Joystick Up
Motor 2:
Motor 3:
Motor 7:
Motor 8:

Right Joystick Down
Motor 2:
Motor 3:
Motor 7:
Motor 8:

Left Joystick Up
Motor 2:
Motor 3:
Motor 7:
Motor 8:

Left Joystick Down
Motor 2:
Motor 3:
Motor 7:
Motor 8:

27. What happens when you move the joysticks along axes 1 and 4?
    _____
28. Which motor ports does channel 2 seem to control?

_____

29. Which motor ports does channel 3 seem to control?

_____

30. Let's imagine you removed the wheel assembly from motor port 2 and plugged it into motor port 1. Which joystick do you think would control the wheel assembly? Which direction would you have to move that joystick?

_____

31. Turn the Vex controller off and remove the jumper. Turn the robot back on and test the controls again. What is different?

_____

32. What seems to be the function of the jumper when it is in Analog/Digital port 15?

_____

33. Imagine that you were using the transmitter to control a car-like robot, rather than this experimental test bed. Compare the behavior of the robot without a jumper to that of the robot with a jumper in Analog/Digital port 15.

_____

Four Wheel Drive in 12 Mode

34. You should still have 4 wheel assemblies that use motor modules.
35. Plug the wheel assemblies into motor ports 1, 2, 7, and 8.
36. Place a jumper clip on Analog/Digital port 16 to enable Four Wheel Drive in 12 Mode.
37. Set the transmitter to Drive Mode 12.
38. List the action, including direction of rotation, of the four wheel assemblies under the following conditions:

Right Joystick Up	Right Joystick Down
Motor 2:	Motor 2:
Motor 3:	Motor 3:
Motor 7:	Motor 7:
Motor 8:	Motor 8:

Right Joystick Left	Right Joystick Right
Motor 2:	Motor 2:
Motor 3:	Motor 3:
Motor 7:	Motor 7:
Motor 8:	Motor 8:

39. What do the wheel assemblies do when you move the left joystick?

_____

40. What do you think would happen if you removed the wheel assemblies from motor ports 1 and 2 and placed them in ports 3 and 4?

_____

41. Turn the Vex controller off and remove the jumper. Turn the robot back on and test the controls again. What is different?

    _____

42. What seems to be the function of the jumper when it is in Analog/Digital port 15?

    _____

43. Imagine that you were using the transmitter to control a car-like robot, rather than this experimental test bed. How would this robot's behavior be different from that when the jumper is in port 15 and the transmitter is in Drive Mode 23?

    _____

44. How would this robot's behavior be different from that when no jumper is being used?

    _____

Software 12 Mix

45. You should still have 4 wheel assemblies that use motor modules, and they should still be plugged into ports 1, 2, 7, and 8.
46. Place a jumper clip on Analog/Digital port 14 to enable Software 12 Mix Mode.
47. Set the transmitter to Drive Mode 23.
48. List the action, including direction of rotation, of the four wheel assemblies under the following conditions:

Right Joystick Up	Right Joystick Down
Motor 2:	Motor 2:
Motor 3:	Motor 3:
Motor 7:	Motor 7:
Motor 8:	Motor 8:

Right Joystick Left	Right Joystick Right
Motor 2:	Motor 2:
Motor 3:	Motor 3:
Motor 7:	Motor 7:
Motor 8:	Motor 8:

49. What do the wheel assemblies do when you move the left joystick?

    _____

50. What do you think would happen if you removed the wheel assemblies from motor ports 1 and 2 and placed them in ports 3 and 4?

    _____

51. Which Drive Mode does the test bed seem to be in? 12 or 23?

    _____

52. In a previous exercise, you chose the Drive Mode through the transmitter's options. How did you choose the Drive Mode in this exercise?

    _____

53. Is there any difference between the Drive Mode now when compared to the same Drive Mode when it is chosen through the transmitter options? (HINT: Pay close attention to the speed of the wheel assemblies.)

_____