Design Portfolio for Robot Challenge

Class and Period: _____ Date: _____

List Students in Team:

_____ _____

_____ _____

_____ _____

Materials you will need: ☐ LEGOS ☐ RCX block ☐ infrared transmitter ☐ computer ☐ protractor ☐ ruler ☐ challenge board

State what the design challenge is:

_____

_____

_____

_____

1. Clarify the Design Specifications and Constraints

What are the specifications and constraints the design must meet?

_____

_____

_____

_____

_____

_____

2. Research and Investigate

In order to better complete the design challenge, you need to first gather information to help you build a knowledge base.

Knowledge and Skill Builder 1: Building a LEGO Robot

Follow the directions to build a basic robot using information from the Robot Construction Sequence document. You will need wheels, plates, bricks, gears, axles, beams with holes and connectors. You will also use the RCX block with 2 motors and wires. As you are building, notice how the pieces overlap each other and the RCX block is secured with beams and connectors. A robust robot will survive frequent handling without falling apart.

Use the wires to connect the motors to the ports on the RCX labeled A and C.

Knowledge and Skill Builder 2: Testing the Robot

Study the RCX block, and label the parts below. Refer to the Programming Power Point document in completing this section.

Select program 1 and press run. (Catch the robot and press run again to stop the program.

Does the robot go forward? _____

Now rotate the connectors on ports A and C 90°.

Does the robot run forward? _____

Change the connectors one more time so that they are rotated 180° from their original position.
Which way does the robot go now? _____

Adjust the wires so that the robot runs forward. Sketch their position on the output ports and the motors to use as a reference.

Take off the wheels and look at the gears.
Count the teeth on driver gear (attached to the motor) and the driven gear (attached to the wheel and axle.)
Write these numbers as a ratio. ___:___ (Driver to Driven)

Reverse the gears. Attach the large gears to the motors and small gears to the wheel and axle. Write this ratio. ___:___ (Driver to Driven)

Run the program again. What do you observe?

_____

Gearing up (small to large) increases torque (power) and decreases speed.
Gearing down (large to small) decreases torque and increases speed.

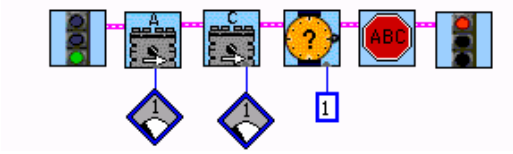
Knowledge and Skill Builder 3: Programming

Follow the directions to write a simple program to make the robot go forward for six seconds and stop (from PowerPoint programming document). Download the program to slot 3. Test the robot.

Knowledge and Skill Builder 4: Distance vs. Time and Power *(pg.3 of the Mathematics KSB document)*

In this investigation, you will test the robot at various power levels and times to study their relationship. You will mark the robot's starting point, run the program, and measure and record the linear distance traveled.

Modify your program to add power levels to the motors and replace the "wait for 6 seconds" with the "wait for time" and add a numeric constant with the value of 1. Download the program to slot 3.



Change the time to 2 seconds and download the program to slot 4.
Change the time to 3 seconds and download the program to slot 5.

Test the robot for each program and record your findings.
Continue modifying, testing and recording your results until you have completed all the trials on the chart.

Left & Right Motor Power Levels For Wheels	Power Level = 1	Power Level = 2	Power Level = 3	Power Level = 4	Power Level = 5
Distance After 1 Second					
Distance After 2 Seconds					
Distance After 3 Seconds					
Distance After 4 Seconds					
Distance After 5 Seconds					
Distance After 6 Seconds					
Distance After 7 Seconds					
Distance After 8 Seconds					
Distance After 9 Seconds					
Distance After 10 Seconds					

Use the data from your chart to help you program the robot to travel a specified distance within the time constraints given by your instructor.

Knowledge and Skill Builder 5: Turns *(p.10 of the Mathematics KSB document)*
In order to make the motor vehicle turn either clockwise or counterclockwise, the most accurate and most efficient method is to make the vehicle change directions about a central point without moving forward, backwards, or to the side. This is done by making the motors attached to the wheels ***rotate*** *in opposite directions – one forwards and one backwards.*

In this investigation, you will conduct several trials and record the number of degrees that the robot turns. You will write a program, center the robot on a line and run the program. When the robot stops, you will use a protractor to measure the degrees of the turn.

Write a program that has the right wheel turn forward and the left wheel turn backwards. Both motors should be on power level 3. Test and record your findings.

Rotation After ___ Seconds											
0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00

What time at power level 3 will give you a rotation of 90^0? _____sec.

Now take the rubber treads off the wheels. This causes two changes to the wheels. What are they?

Run the program that gives a rotation of 90^0 again with the treads off the wheels. What do you observe?

---

3. Generate Alternative Designs

Describe two of your possible solutions to the problem. Remember to consider the specifications and constraints. What are each of the solutions strengths and weaknesses? Include such considerations such as time, ease of fabrication and programming.

4. Choose and Justify the Optimal Design

Choose your preferred solution. Explain how your solution meets the specifications and constraints? Why is this the better alternative?

What trade-offs, if any, did you make in selecting this alternative?

5. Develop a Prototype

Construct your robot. Include a photo or technical drawing of your prototype.

6. Test and Evaluate

Did your design work as expected? Did it meet the initial specifications and constraints? Indicate the tests you conducted and experiments you performed to verify this.

Include at least three copies of your trials and the scores received.

7. Redesign the Solution

What problems did you encounter? What modifications were necessary? If you had time to redesign your model, what changes would you make in your new design?

8. Communicate Your Achievements

Plan how you will communicate your results to your classmates.