

LEGO Engineering Conferences™
ROBOLAB and MINDSTORMS Education
Version 4.5 – March 2008

**NXT-G Program Book II: Intermediate
Robotics Activities for use with the NXT**

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The purpose of this book is to introduce individuals to different ways of utilizing the NXT brick and the NXT-G Program software. Each activity in this book contains learning objectives, and step-by-step building and programming instructions that illustrate how to use the Complete programming palette in the NXT-G Program software. Additional pertinent information will be found at the end of the activities. The primary focus of these Intermediate activities will be on program your brick to utilize sensor data, print text, play music, and draw pictures. As in Book I, these Intermediate NXT-G Program activities progressively build on materials presented in the previous sections.

Activities in this book, assume that the user has experience programming with blocks in the Common Palette in NXT-G. You should also be able to modify the blocks using the configuration panel. If you do not have experience programming in NXT-G, please use the “Introductory” book.

<u>Activities</u>	<u>Level</u>	<u>Page</u>
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Building Instructions for NXT

Section A	NXT - 1
Section B	NXT - 9
Section C	NXT - 11
Section D	NXT - 13
Section E	NXT - 15

LEGO Engineering Conferences™
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The purpose of this book is to introduce individuals to different ways of utilizing the NXT brick and the NXT-G software. Each activity in this book contains learning objectives, and step-by-step building and programming instructions that illustrate how to use the Complete Programming palette in the NXT-G software. Additional pertinent information will be found at the end of the activities. The primary focus of these Intermediate activities will be on program your brick to utilize sensor data, print text, play music, and draw pictures. As in Book I, these Intermediate NXT-G Program activities progressively build on materials presented in the previous sections.

Activities in this book, assume that the user has experience programming with blocks in the Common Palette in NXT-G. You should also be able to modify the blocks using the configuration panel. If you do not have experience programming in NXT-G, please use the “Introductory” book.

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Level 3

Billboard

Learning Objective:

To learn to display text on NXT Screen.



Student Challenge:

Program an NXT to print a message on the NXT screen that will disappear when you press the touch sensor.

Building Procedure:

Step 1: Connect Touch Sensor to Input Port 1.

OR

Step 1: Use a previously built NXT 2-motor vehicle with a Touch Sensor.
(See Building Instructions for NXT – Section C.)

Step 2: Connect one Touch Sensor to Input Port 1.

NXT Wiring Table

Output Port	Hardware	Input Port	Sensor
A	NONE	1	Touch Sensor
B	NONE	2	NONE
C	NONE	3	NONE
		4	NONE

NOTE: You will not need to attach motors to your NXT for this program

Programming Procedure:

Step 1: Open the LEGO MINDSTORMS program and start a new program called *BillBoard*.

Step 2: Click on the  tab at the bottom on the bottom of the Common Block Palette to open the Complete Block Palette.



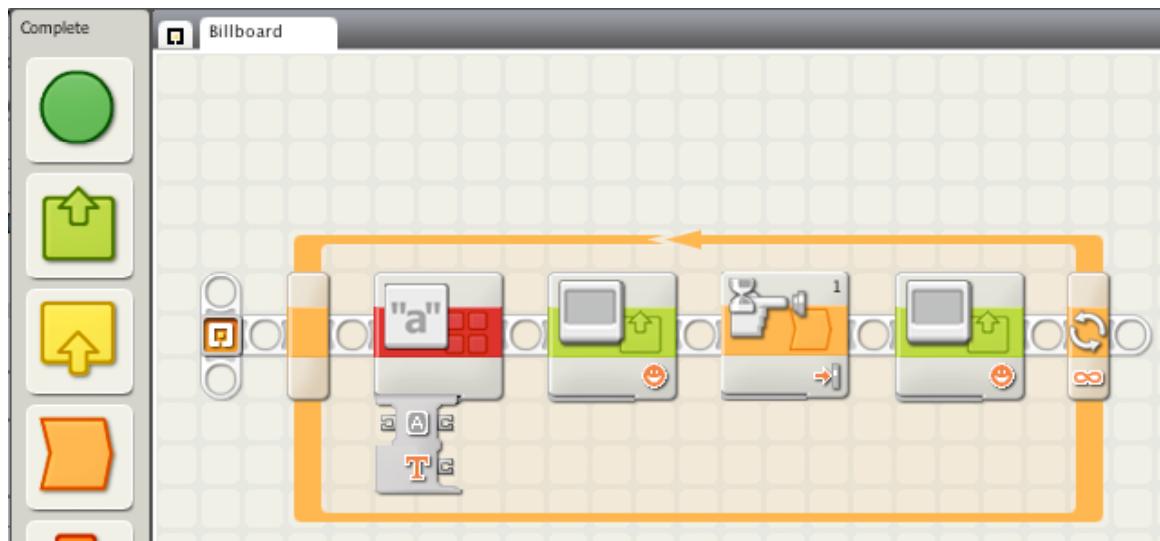
The Complete Block Palette provides you access to ALL the programming blocks that come standard with MINDSTORMS. The Complete Block Palette also provides you with an expanded ability to configure the programming blocks than was available in the Common Block Palette.

NOTE: Programming blocks from both the Common Block Palette and the Complete Block Palette can be used in the same NXT program.

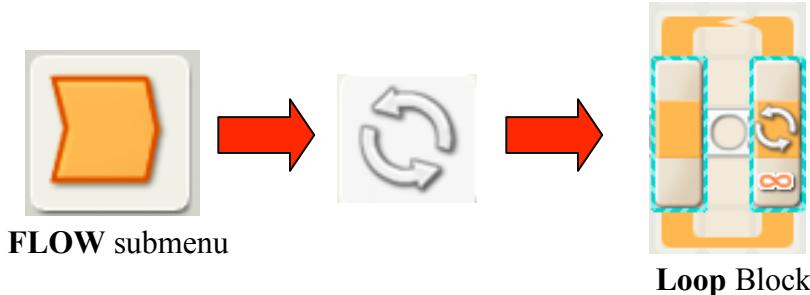
NOTE: The programming blocks available in the Common Block Palette can be accessed in two ways:

- Clicking on the  tab at the *bottom* of the Complete Block Palette will return you to the Common Block Palette.
- Clicking on the  icon at the *top* of the Complete Block Palette will open a submenu containing all the programming blocks from the Common Block Palette.

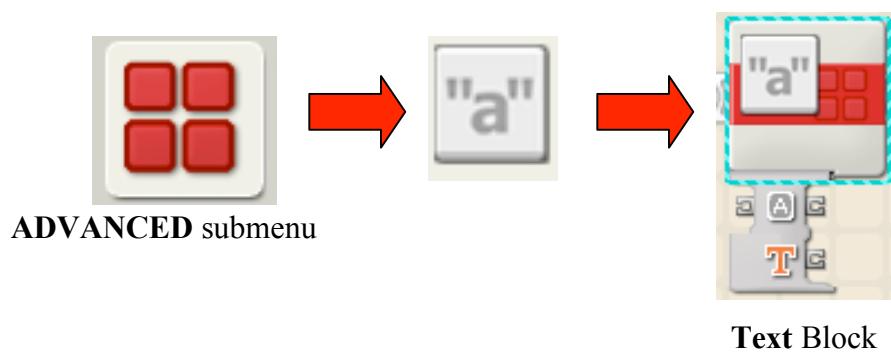
Step 3: Select the following blocks from the Complete Block Palette create a four-block program that matches the one below. You will configure these blocks in **Step 4** to make the *Billboard* program.



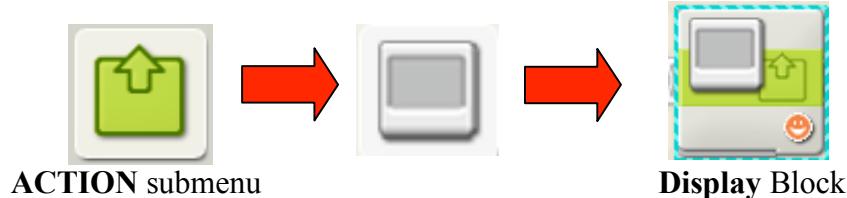
The **Loop** block is available in both the Common and in the Complete Block Palette. Since we're using the Complete Block Palette, select the **Loop** Block from the **FLOW** submenu.



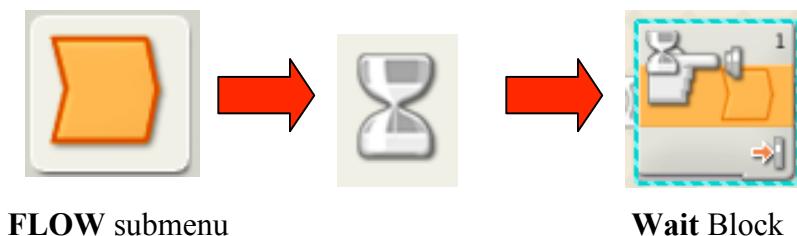
The next block in this program is the **TEXT** block and is under the **ADVANCED** submenu.



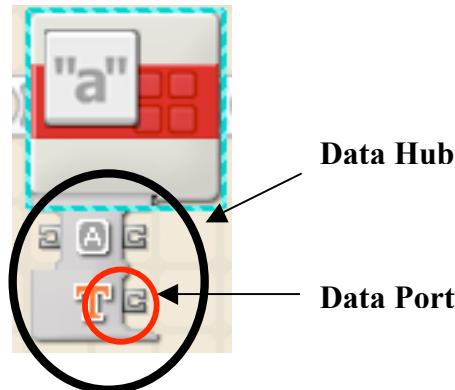
The third block in the program is the **Display** block, selected under the **ACTION** submenu. The **Display** blocks is also the fifth block in this program.



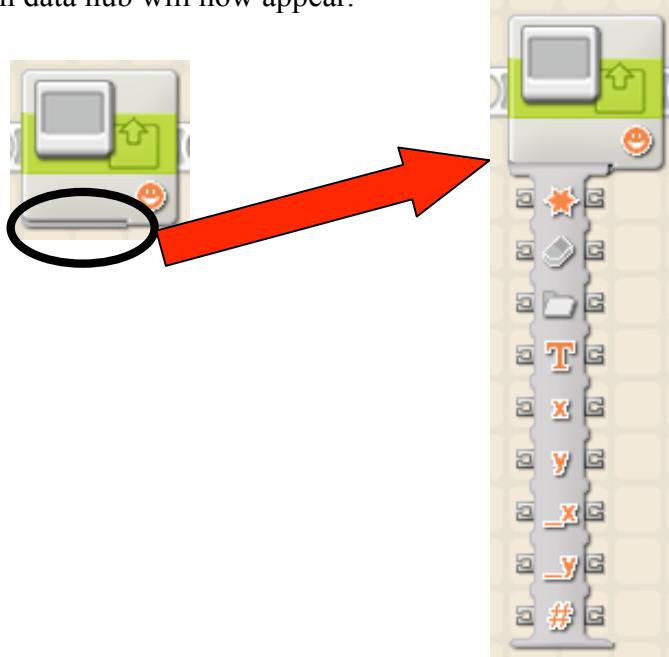
The fourth block in this program is the **Wait** block and is under the **FLOW** submenu.



Step 4: For the **Billboard** program, you will need to access the data hubs of the **Text** and **Display** blocks. The **Text** block automatically has a data hub that sits below the block, and contained in this data hub is a series of data ports. Both the data hub and the data ports contained by the default **Text** block are shown below.



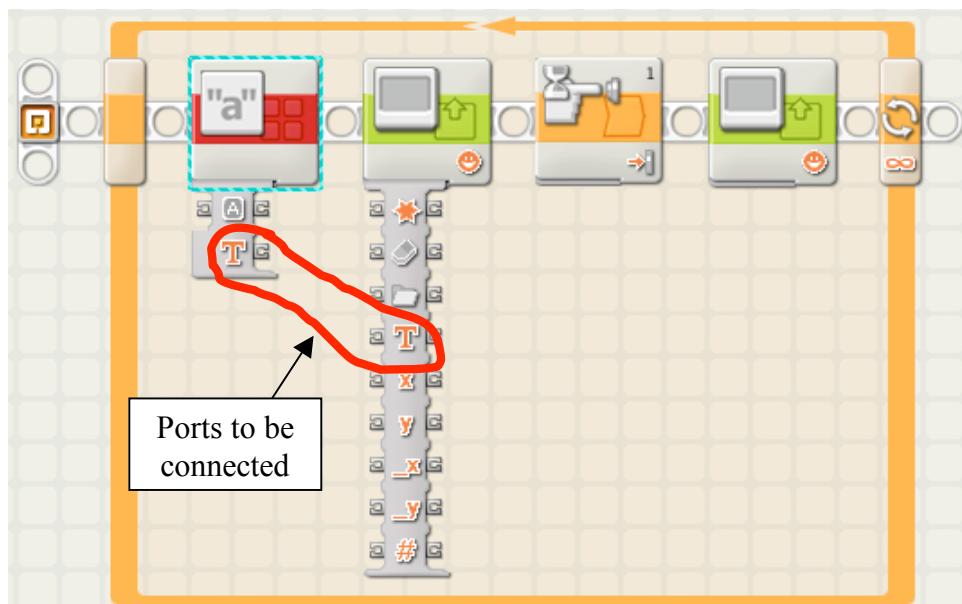
The data hub associated with the **Display** block will be hidden. To access this block, click on the double line on the bottom-left side of the **Display Block**. The hidden data hub will now appear.



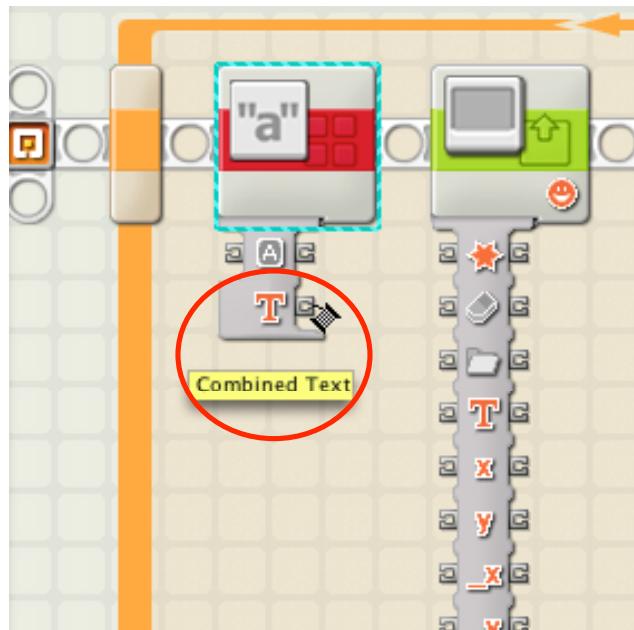
Step 5: You will also need to wire together the data ports of the **Text** block to the **Display Block**.

Wiring the data ports of data hubs together allows your program to directly pass information, such as sensor readings, from one block to another. The blocks can use this data to change how your program functions.

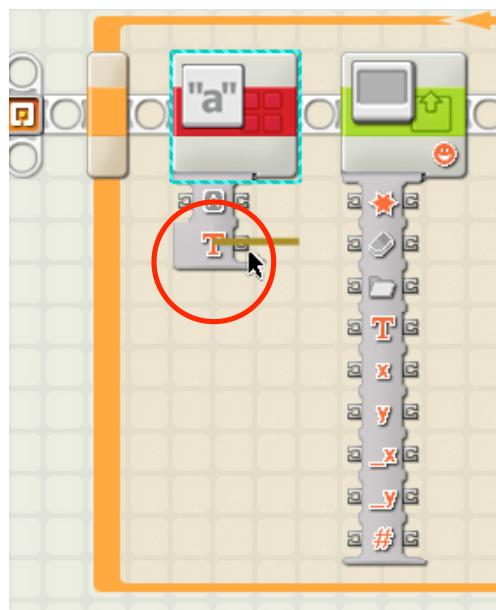
The ports that will be wired together are show in the picture below.



The first step is moving the pointer to the data hub indicated in the picture below. If the pointer is in the correct location, it will turn into a spool and a label that indicates the function of that port. In our case, the port is labeled “Combined Text”.



With the pointer now in the shape of a spool, click and hold down the mouse button. The spool will turn into an arrow and if you move the pointer (while still keeping the mouse button), an orange data wire will follow the pointer.



Drag the pointer over to the top data port in the **Display** block data hub (shown below) and the data wire should follow your pointer.



Release the mouse button and data hubs of the **Text** block and the **Display** block will be wired together.

NOTE: If you release the mouse button and a data wire continues to follow the pointer, you did not connect the data wire properly. To correct this problem, just click on the port you wanted the data wire to connect to; you do not need to hold down the mouse button while dragging the wire to this port.

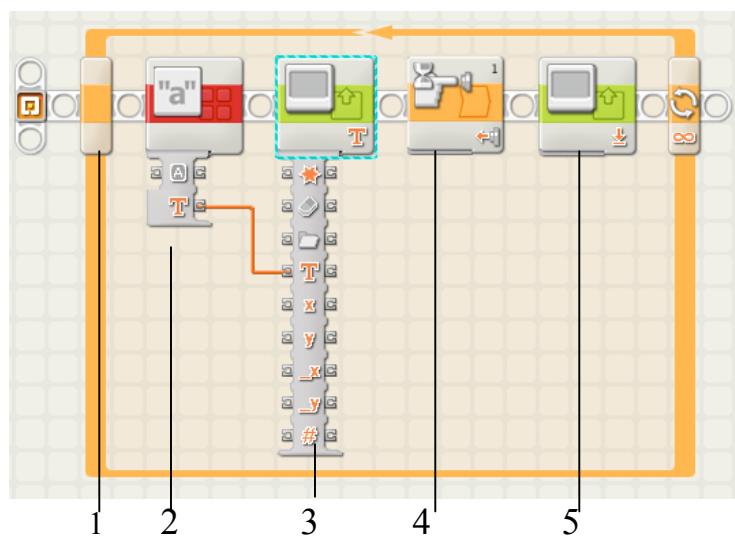
NOTE: MINDSTORMS may automatically change the path of the data wire after you finish dragging it from one data hub to the other. As long as the data wire is connected to the intended ports, the data wire will function properly.

NOTE: If the data wire continues to follow your pointer, pressing the Escape button on the top row of your keyboard will cancel the wiring process and erase the current wire.

Sample Configuration for LEGO Pitch Pipe

In this program, the text 'I WANT MY NXT' (block 2) will be displayed on the NXT brick. When you release the button on the touch sensor (block 4), the screen will clear (block 5) and the message will reappear.

(Continued on Next Page)



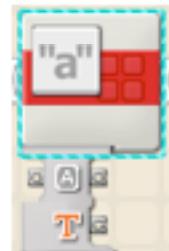
Block # Block Configuration

1
Loop



Control:	Forever
Show:	

2
Text



Text:	A	I
	B	WANT MY
	C	NXT!

3
Display



Action:	Text	Position:
Display:	Clear	
Text:		X 3 Y 20

4
Wait
for
Touch



Control:	Sensor	Port:	1
Sensor:	Touch Sensor	Action:	Bumped

5
Display



Action:	Reset
---------	-------

Step 5: Download this program to your NXT brick. (See previous programs for details.)

Step 6: Run this program and watch your message appear and disappear on the NXT screen.

Additional Information:

In the Classroom:

Age level: 10+

LEGO NXT building: None

Materials

NXT car

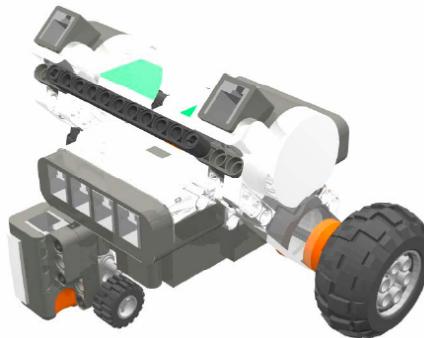
Touch Sensor

Level 3

Line Follower

Learning Objective:

You will program your LEGO vehicle to use a light sensor to follow a black line.



NXT Vehicle with Light Sensor

Student Challenge:

A line made of black electrical tape will be laid down on the workshop floor. Your robot will have to follow that line from one end to another.

Building Procedure:

Step 1: Build a NXT 2-motor vehicle with a Light Sensor.
(See Building Instructions for NXT – Section B.)

Step 2: Connect one motor to Output Port B and another motor to Output Port C.

Step 3: Connect one Light Sensor to Input Port 2.

NXT Wiring Diagram

Output Port	Hardware	Input Port	Sensor
A	NONE	1	NONE
B	Motor	2	Light Sensor
C	Motor	3	NONE
		4	NONE

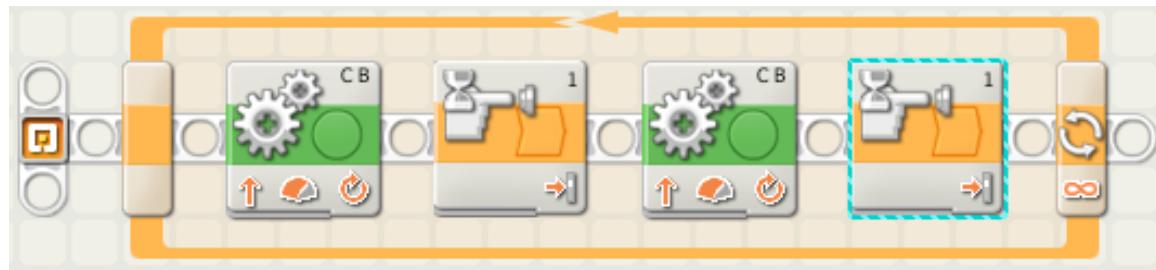
Programming Procedure:

Step 1: Open the LEGO MINDSTORMS program and start a new program called *LineFol*.

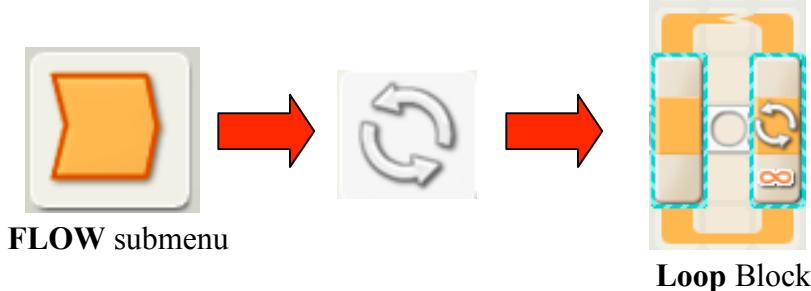
Step 2: Click on the  tab at the bottom to the Common Block Palette to open the Complete Block Palette.



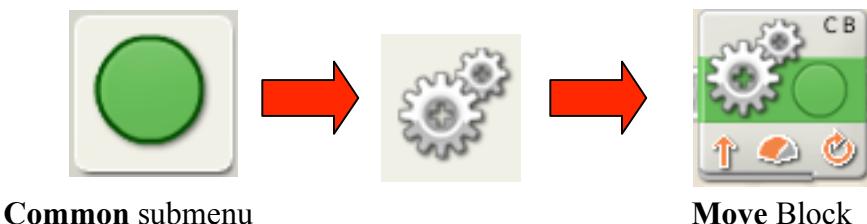
Step 3: Select blocks from the Complete Block Palette to create a five-block NXT program that matches the one below.



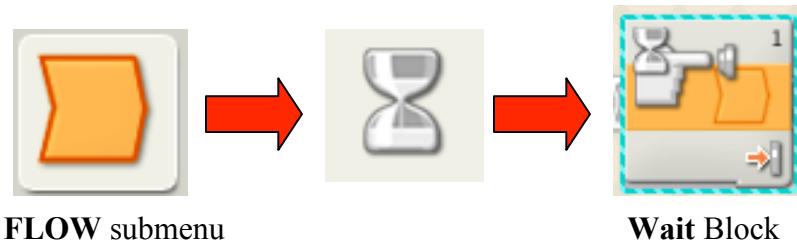
The **Loop** block is available in both the Common and in the Complete Block Palette. Since we're using the Complete Block Palette, select the **Loop** Block from the **FLOW** submenu.



The second and fourth blocks in this program are **Move** blocks. The **Move** block is only found under the **COMMON** submenu.



The third block in the program is called the **Wait** Block and is found under the **FLOW** submenu, just like the **Loop** Block.



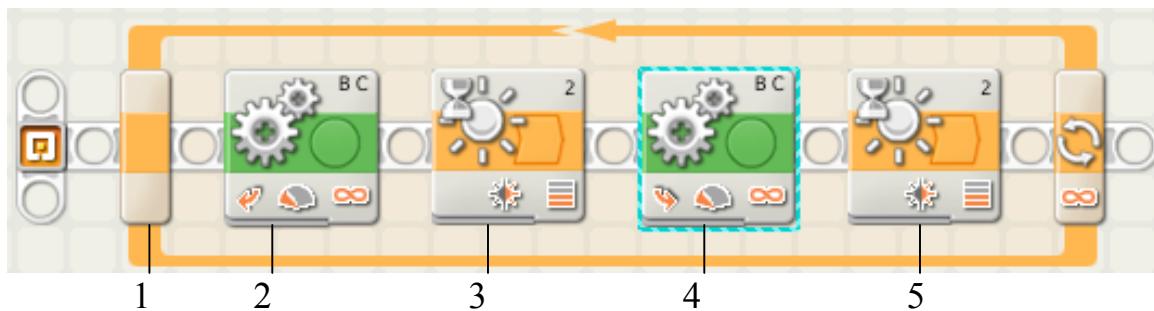
NOTE: Even though the **Wait** Block has a touch sensor associated with it, you will modify the **Wait** Block to interact with the light sensor by using the configuration panel

Step 4: Configure the blocks in your program to make your vehicle follow the black tapeline.

Sample Configuration for the Line Follower

This sample program makes the car move (block 2) until the light sensor detects dark (block 3), which indicates that the car has moved onto the black tapeline. The car then begins veering to the left. (block 4), until the sensor detects light

(block 5). The program repeats (block 1) until the car can no longer find the black tapeline.



Block # Block Configuration

1	Loop		<table border="1"> <tr> <td>Control:</td><td>Forever</td></tr> <tr> <td>Show:</td><td></td></tr> </table>	Control:	Forever	Show:	
Control:	Forever						
Show:							

2	Move		<table border="1"> <tr> <td>Port:</td><td><input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C</td><td>Power:</td><td>35</td></tr> <tr> <td>Direction:</td><td></td><td>Duration:</td><td>Unlimited</td></tr> <tr> <td>Steering:</td><td></td><td>Next Action:</td><td></td></tr> </table>	Port:	<input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C	Power:	35	Direction:		Duration:	Unlimited	Steering:		Next Action:	
Port:	<input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C	Power:	35												
Direction:		Duration:	Unlimited												
Steering:		Next Action:													

3	Wait for Light		<table border="1"> <tr> <td>Control:</td><td>Sensor</td><td>Port:</td><td><input checked="" type="radio"/> 2</td></tr> <tr> <td>Sensor:</td><td></td><td>Until:</td><td>< 50</td></tr> <tr> <td></td><td></td><td>Function:</td><td><input checked="" type="checkbox"/> Generate light</td></tr> </table>	Control:	Sensor	Port:	<input checked="" type="radio"/> 2	Sensor:		Until:	< 50			Function:	<input checked="" type="checkbox"/> Generate light
Control:	Sensor	Port:	<input checked="" type="radio"/> 2												
Sensor:		Until:	< 50												
		Function:	<input checked="" type="checkbox"/> Generate light												

4	Move		<table border="1"> <tr> <td>Port:</td><td><input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C</td><td>Power:</td><td>35</td></tr> <tr> <td>Direction:</td><td></td><td>Duration:</td><td>Unlimited</td></tr> <tr> <td>Steering:</td><td></td><td>Next Action:</td><td></td></tr> </table>	Port:	<input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C	Power:	35	Direction:		Duration:	Unlimited	Steering:		Next Action:	
Port:	<input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C	Power:	35												
Direction:		Duration:	Unlimited												
Steering:		Next Action:													

5	Wait for Light		<table border="1"> <tr> <td>Control:</td><td>Sensor</td><td>Port:</td><td><input checked="" type="radio"/> 2</td></tr> <tr> <td>Sensor:</td><td></td><td>Until:</td><td>> 50</td></tr> <tr> <td></td><td></td><td>Function:</td><td><input checked="" type="checkbox"/> Generate light</td></tr> </table>	Control:	Sensor	Port:	<input checked="" type="radio"/> 2	Sensor:		Until:	> 50			Function:	<input checked="" type="checkbox"/> Generate light
Control:	Sensor	Port:	<input checked="" type="radio"/> 2												
Sensor:		Until:	> 50												
		Function:	<input checked="" type="checkbox"/> Generate light												

NOTE: You will need to modify the light intensity value in Block 3 and Block 6 to represent the light reading when the light sensor is pointed at the floor.

Step 5: Download this program to your NXT brick. (See previous programs for details.)

Step 6: Place your car on the ground, with the Light sensor on the left edge of the black line and run this program to see if the NXT vehicle travels down the line.

Additional Information:

In the Classroom:

Age level: 10+

LEGO NXT building: None

Materials

NXT car

Black electrical tape line

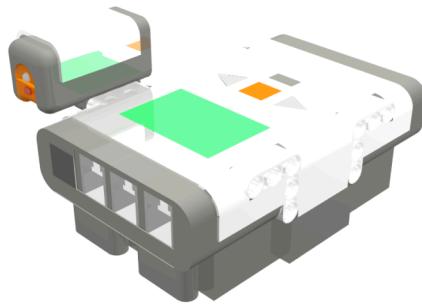
NOTE: When making the tape line, the NXT sensor has a difficult time with sharp corners. Therefore, do not make any turns in the tape line great than 65 degrees

Level 4

LEGO Pitch Pipe

Learning Objective:

This activity introduces a way to expand the power of blocks through data hubs.



NXT with Light Sensor

Student Challenge:

Program a LEGO Pitch Pipe that plays higher pitches when the light is bright and lower pitches when the light is dim.

Building Procedure:

Step 1: Connect one Light Sensor to Input Port 2.

OR

Step 1: Use a previously built NXT 2-motor vehicle with a Light Sensor.
(See Building Instructions for NXT – Section B.)

Step 2: Connect one Light Sensor to Input Port 2.

NXT Wiring Table

Output Port	Hardware	Input Port	Sensor
A	NONE	1	NONE
B	NONE	2	Light Sensor
C	NONE	3	NONE
		4	NONE

NOTE: You will not need to attach the motors of your NXT vehicle to the Output Ports for this activity.

Programming Procedure:

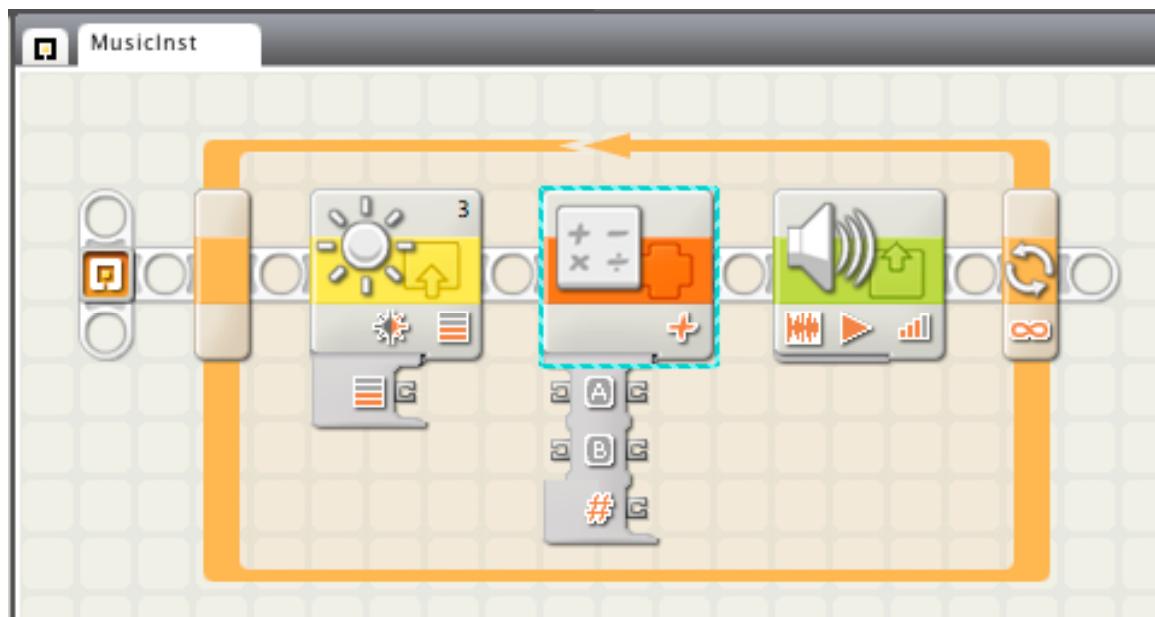
Step 1: Open the LEGO MINDSTORMS program and start a new program called *PitchPipe*.

Step 2: Click on the  tab at the bottom to the Common Block Palette to open the Complete Block Palette.

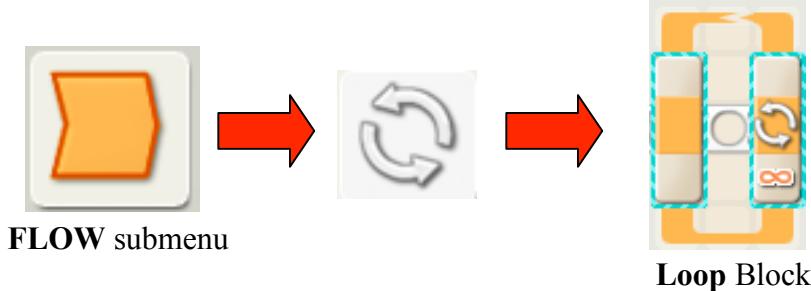


Step 3: Select blocks from the Complete Block Palette to create a four-block NXT-G program that matches the one below. You will use the directions in **Step 4** to configure these blocks to make the *LEGO Pitch Pipe* program.

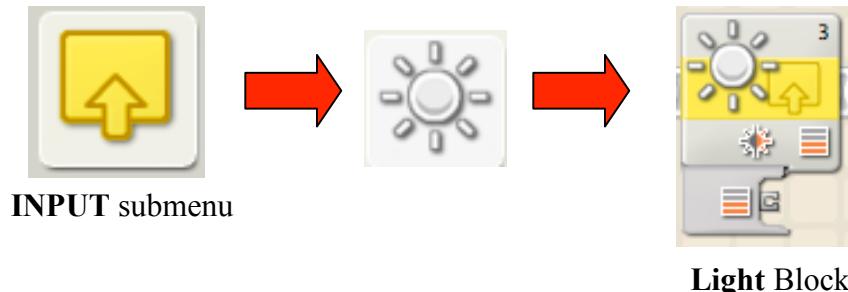
(Step 4 continued on next page)



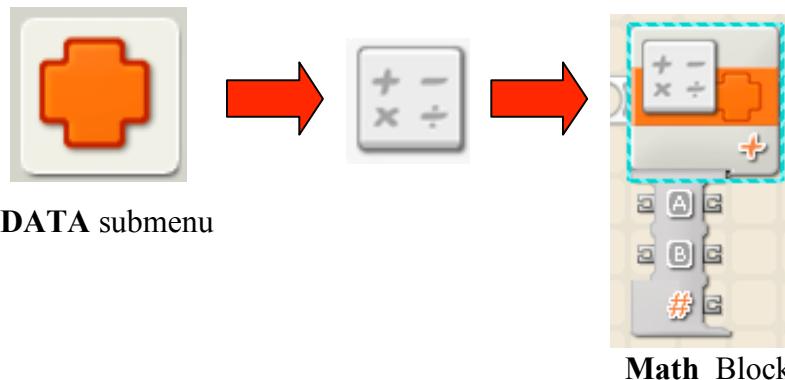
The **Loop** block is available in both the Common and in the Complete Block Palette. Since we're using the Complete Block Palette, select the **Loop** Block from the **FLOW** submenu.



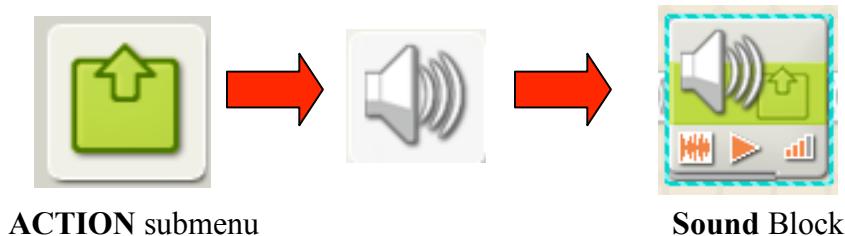
The next block in this program is the **LIGHT** block and is under the **INPUT** submenu.



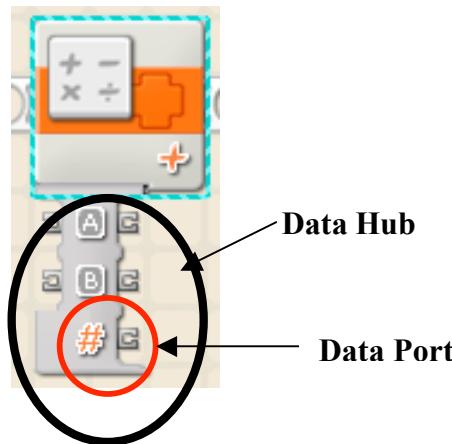
The third block in the program is called the **Math** Block and is found under the **DATA** submenu.



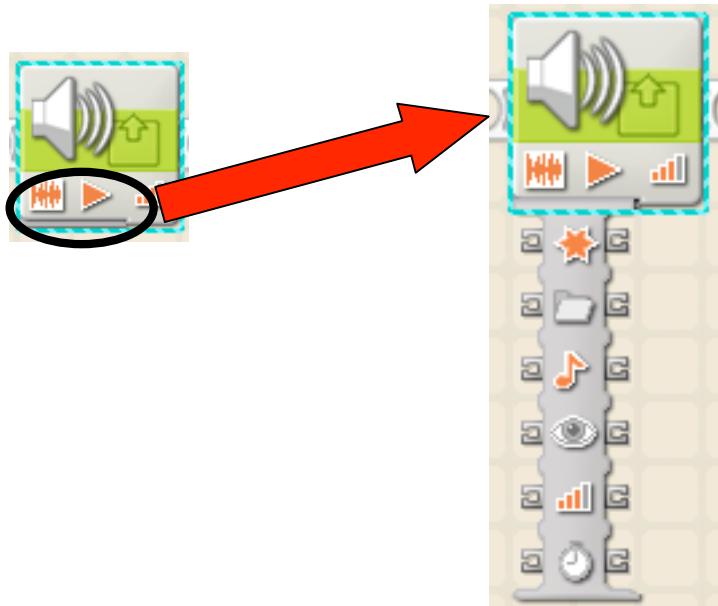
The final block in the program, the **Sound** block, is found in the Complete Block Palette under the **ACTION** submenu.



Step 4: For the **Music Box** program, you will need to access the data hubs of the **Math** and **Sound** blocks. The **Math** block will automatically have a data hub that sits below the block. Within the data hub will be a series of data ports.

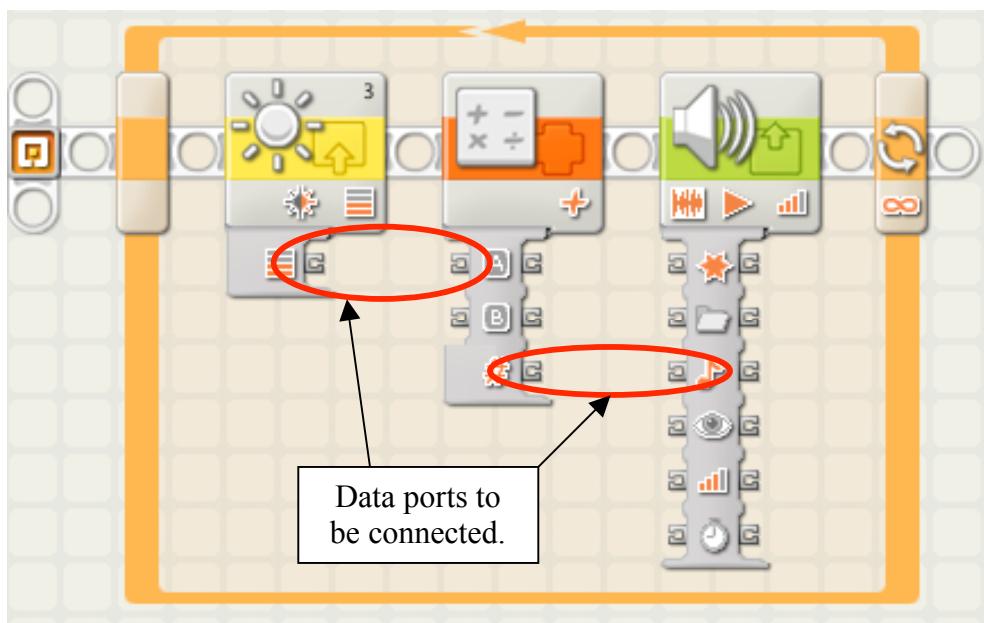


Click on the double line on the bottom-left side of the **Sound** Block to reveal the hidden data hub.



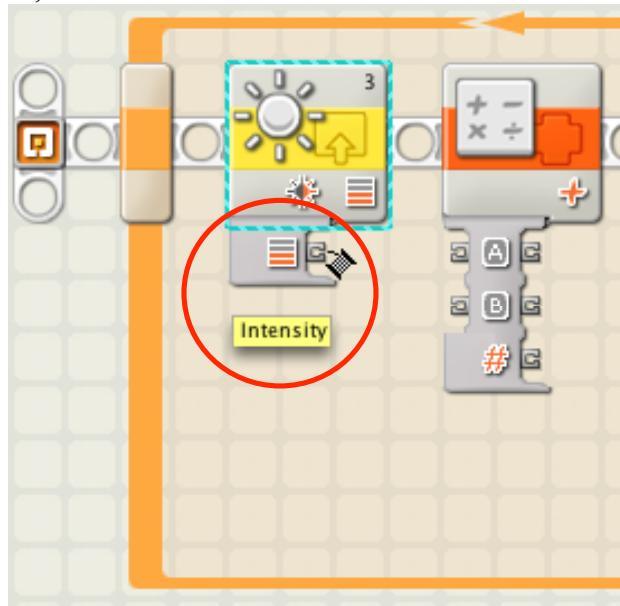
Step 5: For this program, you will also need to wire together data ports on the data hubs of the **Light** block to the **Math** block. You will also wire together data ports of the data hub in the **Math** block and the **Sound** block.

Wiring data ports of data hubs together allows your program to pass information, such as sensor readings, directly from one block to another. The blocks can use this data to change how your program functions. In our case, the light intensity value recorded by the **Light** block, modified by the **Math** block, will adjust the pitch of the noise produced by the **Sound** block.



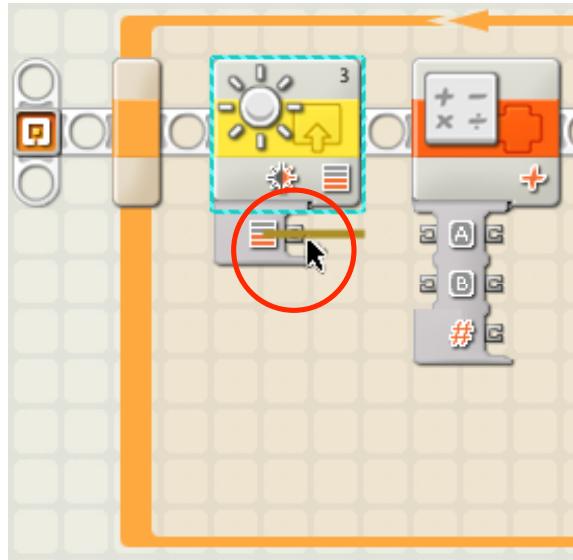
Wiring Process

To start the process of wiring, move the mouse pointer over the port on the **Light** block data hub, as shown below.

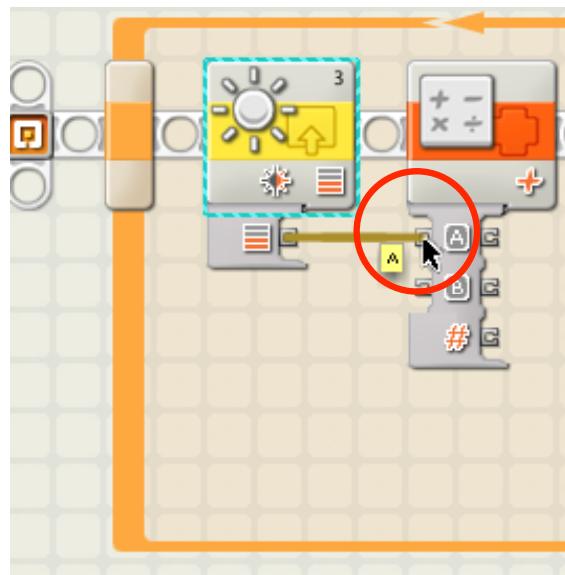


If the pointer is at the proper location, the pointer should turn into a spool shape. A small yellow box, describing the function of that port of the data hub, will also appear. In the example above, the selected port of the **Light** block's data hub will return information about the light intensity detected by the light sensor.

With the pointer in the shape of a spool, click and hold down the mouse button. The spool will turn into an arrow and if you move the pointer (while still keeping the mouse button) the orange data wire will follow the pointer to the next data hub.



Drag the pointer over to the top port in the **Math** block data hub and the data wire should follow your pointer.



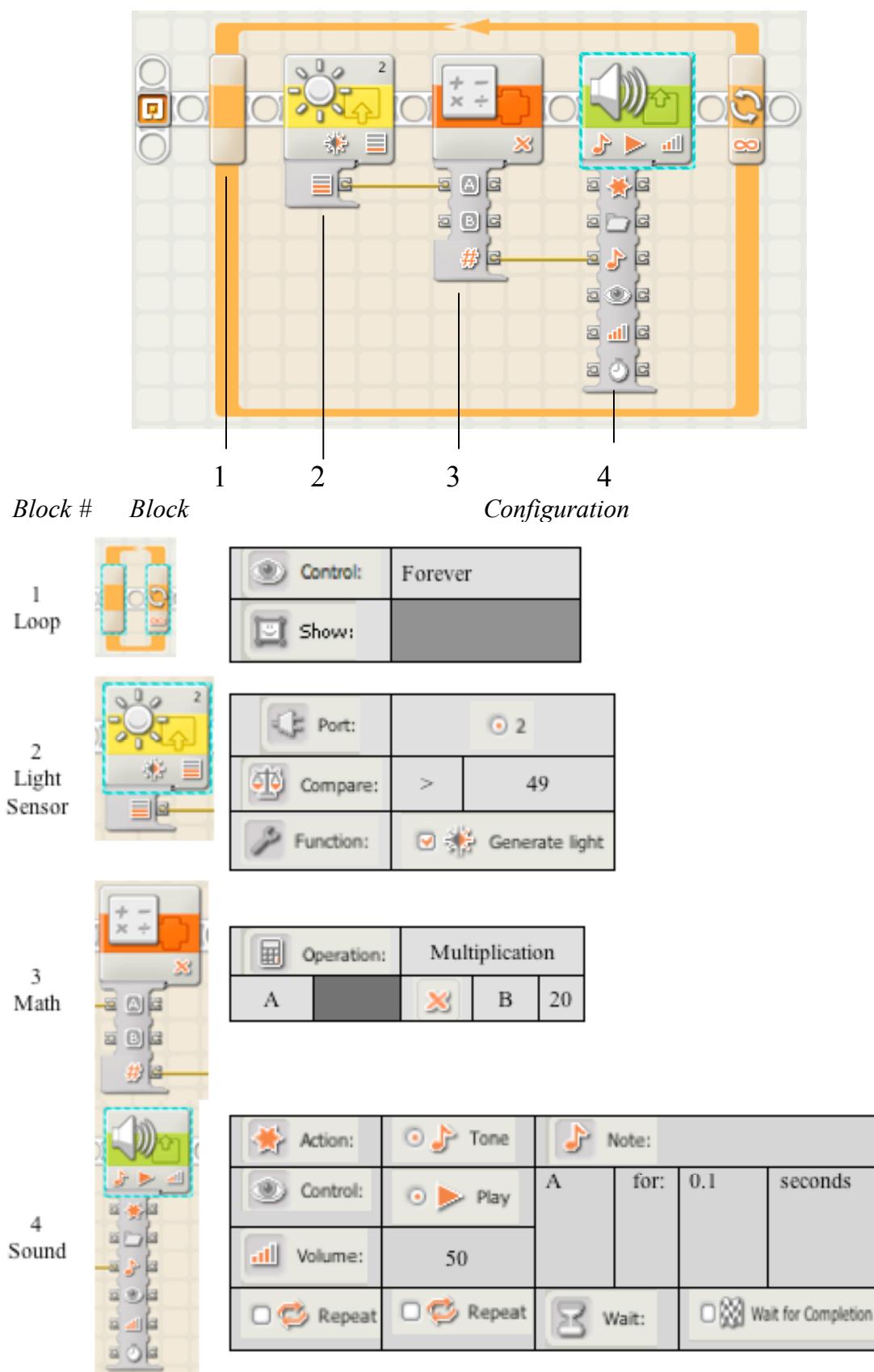
Release the mouse button and data hubs of the **Light** block and the **Math** block will be wired together.

NOTE: If you release the mouse button and a data wire continues to follow the pointer, you did not connect the data wire properly. To correct this problem, just click on the port you wanted the data wire to connect to; you do not need to hold down the mouse button while dragging the wire to this port.

NOTE: MINDSTORMS may automatically change the path of the data wire after you finish dragging it from one data hub to the other. However, as long as the data wire is connected to the intended ports, the data wire will function properly.

Sample Configuration for LEGO Pitch Pipe

In this program, the light sensor (block 2) will detect a light level and then the NXT brick will play a tone (block 4) corresponding to that reading before looping (block 1) back to the beginning of the program. The light reading needs to be multiplied (block 3) by 20 to make the value become a tone that the NXT brick can produce.



NOTE: This program will require you to connect the light value detected by the **Light Sensor Block** (block 2) using **Math Block** (block 3) and onto the **Sound Block** (block 4).

Step 5: Download this program to your NXT brick. (See previous programs for details.)

Step 6: Run this program and listen to the music produced as you move your NXT brick around.

Additional Information:

In the Classroom:

Age level: 10+

LEGO NXT building: None

Materials

NXT car

Flashlight or Light Source

Level 4

NXTaSketch

Learning Objective:

Learn to program the NXT motors to work as rotation sensors.



Student Challenge:

Build an NXTaSketch or a device to draw a picture on the screen of your NXT brick, where the rotation sensors in the NXT motors control the shape and direction of the lines.

Building Procedure:

Step 1: Build a NXT 2-motor vehicle with a Touch sensor.
(See Building Instructions for NXT – Section C.)

Step 2: Connect one motor to Output Port B and another motor to Output Port C.

Step 3: Connect one Touch Sensor to Input Port 1.

NXT Wiring Diagram

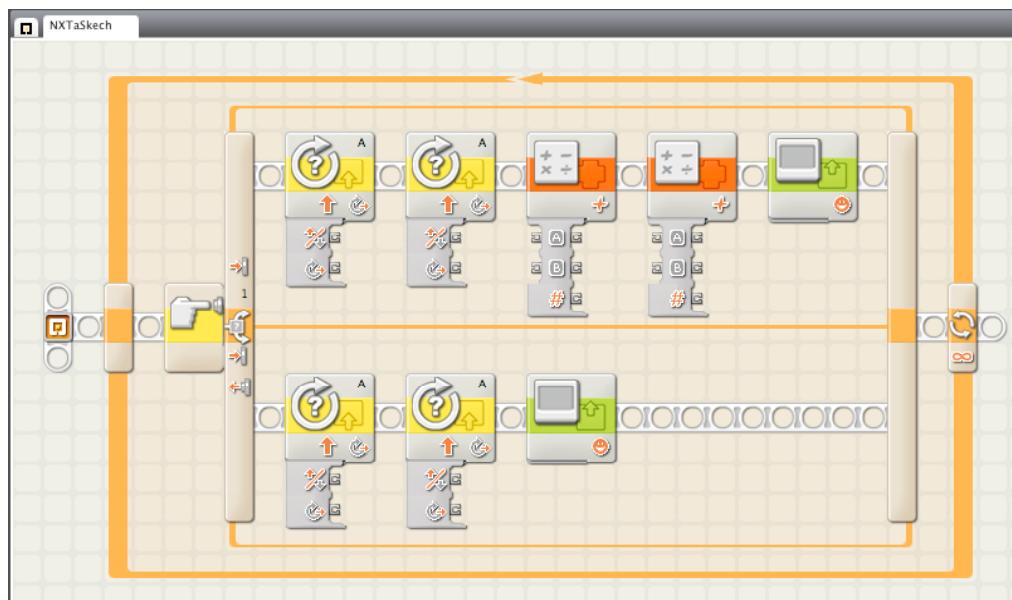
Output Port	Hardware	Input Port	Sensor
A	NONE	1	Touch Sensor
B	Motor	2	NONE
C	Motor	3	NONE
		4	NONE

Programming Procedure:

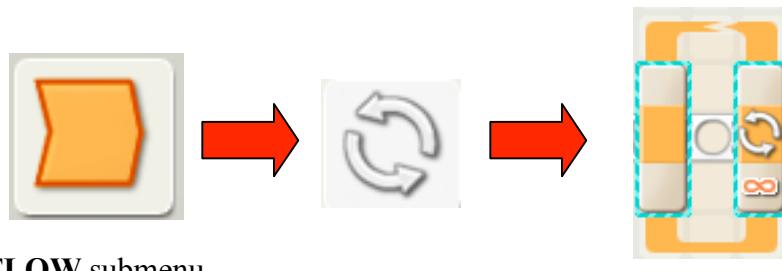
Step 1: Open MINDSTORMS and start a new program titled *NXTSketch*. (See previous sections for details.)

Step 2: Click on the  tab at the bottom of the Common Block Palette to open the Complete Block Palette.

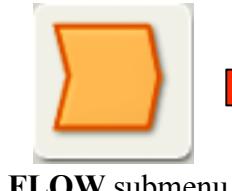
Step 3: Select blocks from the Complete Block Palette to create a 10-block NXT program that matches the one below. You will then use the directions in Step 4 to modify these blocks to create your *NXTaSketch* program.



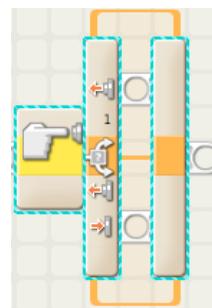
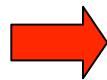
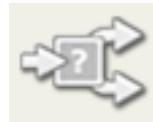
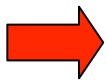
The **Loop** Block is located in the **FLOW** submenu.



For this program, you will need the **Switch** Block, which is also located in the **FLOW** submenu.



FLOW submenu



SWITCH Block

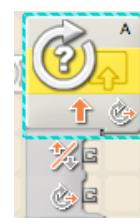
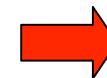
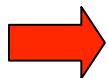
The **Switch** Block makes the program check whether a specific condition has been met – such as a button being pressed. If the condition has occurred (i.e. the button has been pressed), the program runs the blocks in the top row of the **Switch** Block; otherwise, the program runs the blocks in the bottom row of the **Switch** Block.

NOTE: The **Switch** block will expand as you place blocks into either the top or bottom row of the **Switch** block, similar to the **Loop** block.

Another new block in this program is the **Rotation Sensor** Block, located within the **SENSOR** submenu. 4 **Rotation Sensor** Blocks will be used in this program.



SENSOR submenu



Rotation Sensor Block

The **Math** block and is found under the **DATA** submenu. Two **Math** blocks will be used in this program.

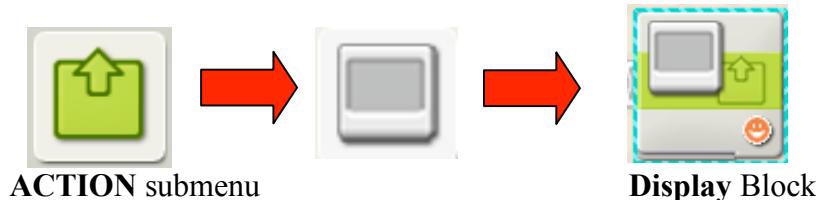


DATA submenu



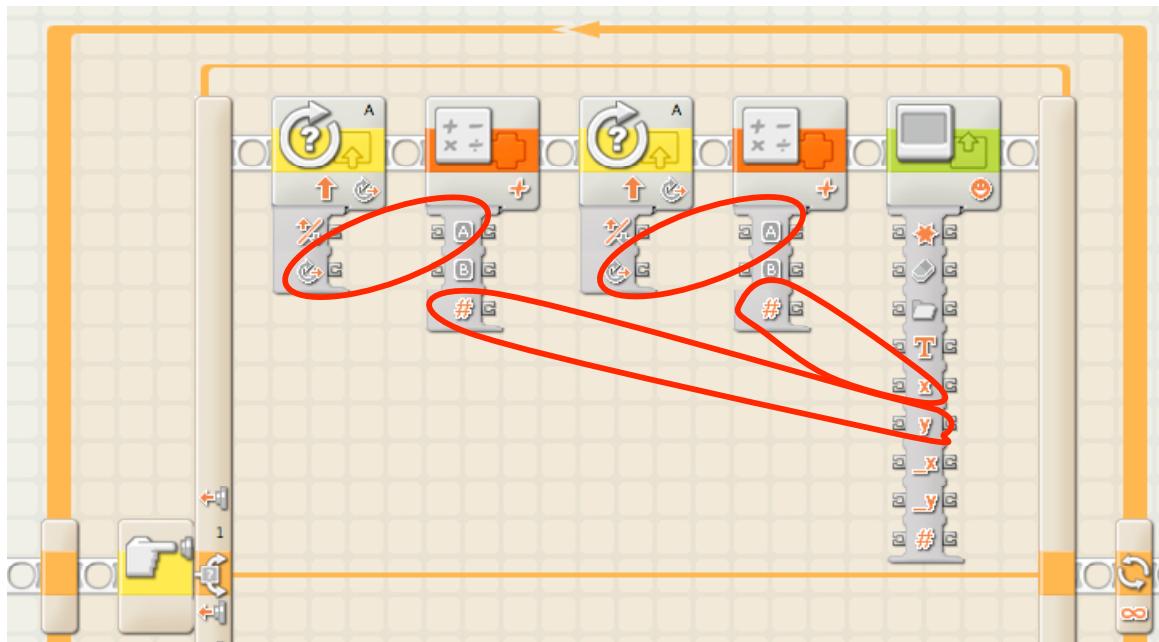
Math Block

The final block necessary for this program is the **Display** block, selected under the **ACTION** submenu. Two **Display** blocks will be used in this program.



Step 4: You will need to expand the Data Hub in the **Display** block for the *NXTaSketch* program.

Step 5: You will need to wire together four data ports for the *NXTaSketch* program as indicated below. (Refer to previous sections in this manual for detailed data port wiring instructions.)



Step 6: After you have finished wiring your program, you will want to minimize the data hub associated with the **Display** block. Minimizing the data hub will cause all the unwired ports on the data hub to hide, reducing the amount of space the data hub take up on the screen.

After you have wired the ports in the data hub of the **Display** block, move the mouse pointer to the bottom, left corner of the **Display** block. When you have moved the pointer to the proper position, the pointer will change into a doubled-lined icon pictured below.



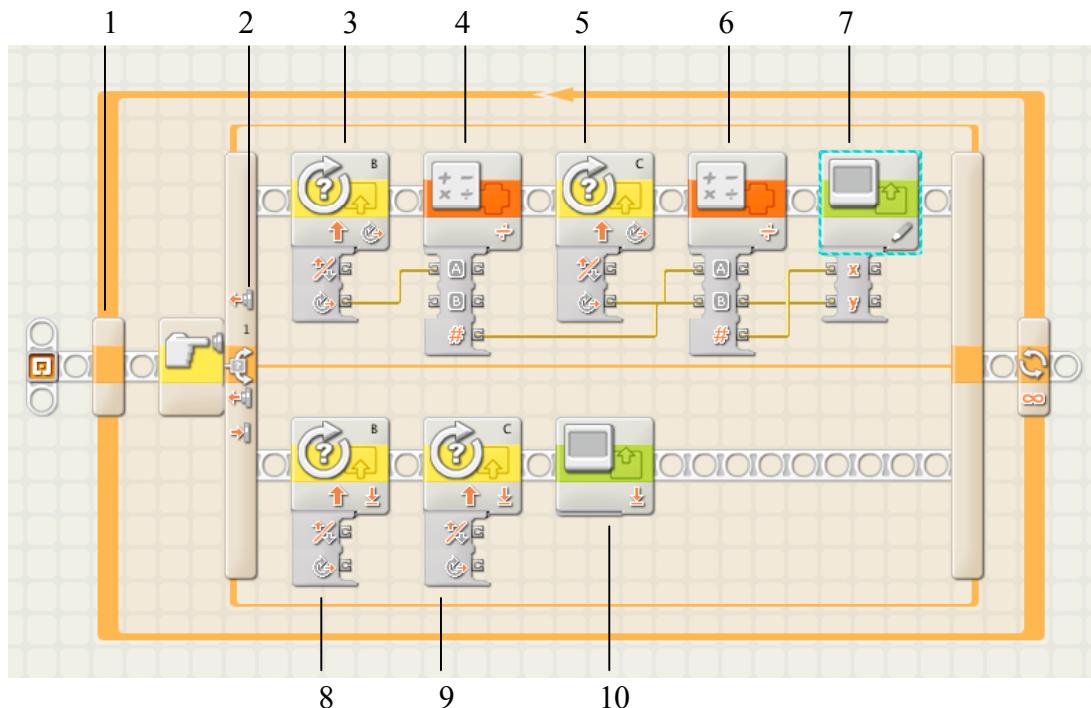
Once your mouse is moved into the proper position, click *once* to minimize the data hub down to only the data ports that are used in this program.



NOTE: Your program will resize itself when you minimize the data hub. Also, the path of the data wires in your program may change. If you properly connected the data wires, the new path of the wires will not impact your program – even if the wires now appear to connect to other data hubs.

Sample Configuration for NXTaSketch

A line will be drawn on the NXT screen (block 7) where the amount of rotation on motor B controls the Y coordinate of the line (block 3) and the rotation on motor C controls the X coordinate (block 4). If the touch sensor (block 2) is pressed and released, any drawing already on the screen will be erased (block 10) and the rotation sensor values are reset to zero (block 8 & block 9).



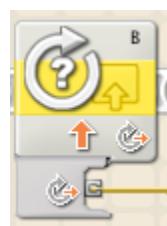
Block #	Block	Configuration		
1 Loop			Forever	
2 Switch		 	Port: 1	

(Continued on next page)

Block #

Block

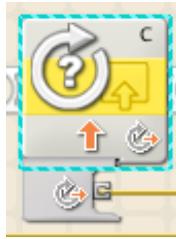
Configuration

3
Rotation
Sensor

	Port:	<input checked="" type="radio"/> B	
	Action:	<input checked="" type="radio"/>	Read
	Compare:	<input checked="" type="radio"/>	
		360	Degrees

4
Math

	Operation:	Division		
A			B	20

5
Rotation
Sensor

	Port:	<input checked="" type="radio"/> C	
	Action:	<input checked="" type="radio"/>	Read
	Compare:	<input checked="" type="radio"/>	
		360	Degrees

6
Math

	Operation:	Division		
A			B	20

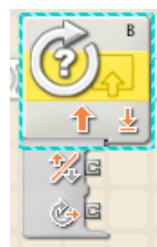
7
Display

	Action:	Drawing		
	Display:	<input type="checkbox"/> Clear		
	Type:	Point	X	3
			Y	20

(Continued on next page)

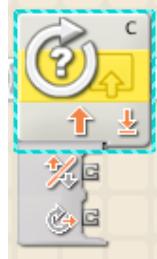
Block # Block Configuration

8
Rotation
Sensor



Port:	<input checked="" type="radio"/> B
Action:	<input checked="" type="radio"/> Reset
Compare:	<input checked="" type="radio"/> <input type="checkbox"/> >
	360 Degrees

9
Rotation
Sensor



Port:	<input checked="" type="radio"/> C
Action:	<input checked="" type="radio"/> Reset
Compare:	<input checked="" type="radio"/> <input type="checkbox"/> >
	360 Degrees

10
Display



Action:	Reset
---------	-------

NOTE: The division that occurs in blocks 4 and block 6 are necessary to scale the rotation of the motors to the size of the NXT screen. Change these values and see what happens.

NOTE: When you reset your program (by pressing the touch sensor), the screen will briefly indicate that your NXTaSketch program is still running – rather than just clearing the screen.

Step 5: Save and download this program to your NXT brick

Step 6: Run this program and draw a picture.

Additional Information:

In the Classroom:

Age level: 10+

LEGO NXT building: None

Materials

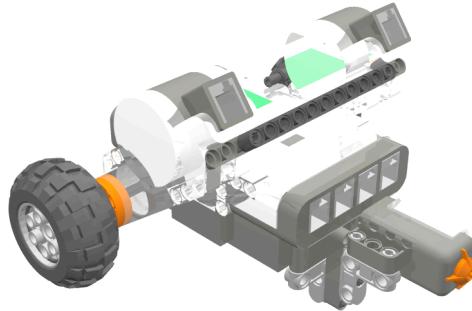
NXT car

Open-Ended Activity

Relay Race

Learning Objective:

Build an NXT car and program it to drive to another NXT vehicle, triggering the second NXT to perform a behavior.



NXT Car with a Touch Sensor

Student Challenge:

You will need to work with a partner for this activity. Each partner will need to build a robotic NXT car with a Touch Sensor.

Building Procedure:

Step 1: Build a NXT 2-motor vehicle with a Touch Sensor.
(See Building Instructions for NXT – Section C.)

Step 2: Connect one motor to Output Port B and another motor to Output Port C.

Step 3: Connect a Touch sensor to Input Port 1.

Programming Procedure:

Step 1: Open LEGO MINDSTORMS and start a new program

NXT CAR Programmed to Drive First

Step 2: Select blocks from the Common Block Palette to create a 3 block NXT-G program that will make your NXT vehicle forward to start the relay race and then return to its starting point when it bumps into the second NXT vehicle.

A sample program is included below



Block #	Block	Configuration			
1 Move		<input type="checkbox"/> Port: B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> Power: 50	
		<input type="checkbox"/> Direction:	<input type="checkbox"/> Duration:	<input type="checkbox"/> Steering: 0	Unlimited
		<input type="checkbox"/> Sensor:	<input type="checkbox"/> Port: 1	<input type="checkbox"/> Action:	
2 Wait for Touch		<input type="checkbox"/> Sensor:	<input type="checkbox"/> Port: 1	<input type="checkbox"/> Action:	
3 Move		<input type="checkbox"/> Port: B	<input checked="" type="checkbox"/> C	<input type="checkbox"/> Power: 50	
		<input type="checkbox"/> Direction:	<input type="checkbox"/> Duration: 4 Seconds	<input type="checkbox"/> Steering: 0	
		<input type="checkbox"/> Sensor:	<input type="checkbox"/> Port: 1	<input type="checkbox"/> Action:	

NXT CAR Programmed to Drive Second

Step 2: Select blocks from the Common Block Palette to create a 3 block NXT-G program that will make your NXT vehicle go forward for the second part of the relay race, when the NXT vehicle's touch sensor is pressed by the other vehicle.

A sample program is included below



1
Wait
for
Touch



Control:	Sensor	Port:	1
Sensor:	Touch Sensor	Action:	Bumped

2
Move



Port:	B C	Power:	50
Direction:	Up	Duration:	Unlimited
Steering:	0	Next Action:	

3
Move



Port:	B C	Power:	50
Direction:	Down	Duration:	4 Seconds
Steering:	0	Next Action:	Brake

ADDITIONAL INFORMATION:

Extension

In the Classroom

Age level: 11+

Programming level: Complete Block Palette

LEGO building: Beginner

Objective: Using Touch Sensor

Materials

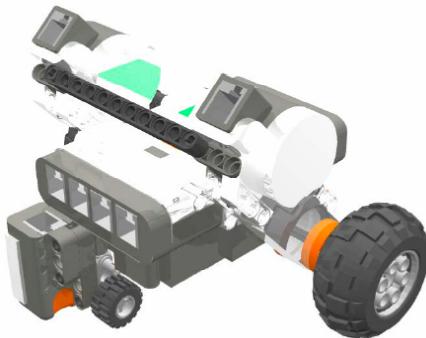
NXT car

NXT Touch Sensor

Open-Ended Activity Around the Block

Learning Objective:

Build a robotic NXT LEGO car equipped with a light sensor and program it to drive and then turn based on light input.



NXT Car with Light Sensor

Student Challenge:

Build and program a two-motor car equipped with a light sensor. The car should drive forward and then turn when a flashlight is pointed at the light sensor. The car should drive in a square so it ends up at the beginning position.

Building Procedure:

Step 1: Build a NXT 2-motor vehicle with a Light sensor.
(See Building Instructions for NXT – Section B.)

Step 2: Connect one motor to Output Port B and another motor to Output Port C.

Step 3: Connect one Light Sensor to Input Port 2.

Programming Procedure:

This program will cause Motors B and C to drive forward until the light sensor on Port 2 sees light (the flashlight). This input will make the car turn. When the light sensor sees darker (the flashlight is taken away), both motors will turn in the forward direction. The program will loop four times. See if you can make your NXT car make a square. .

A sample program is provided below.

1
Loop

Control:	Forever	
Until:	Count	4
Show:		

2
Move

Port:	<input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C	Power:	50
Direction:	↑	Duration:	Unlimited
Steering:	↔	Next Action:	

3
Wait
for
Light

Control:	Sensor	Port:	<input checked="" type="radio"/> 2
Sensor:	Light Sensor	Until:	> 50
		Function:	Generate light

4
Move

Port:	<input checked="" type="checkbox"/> B <input checked="" type="checkbox"/> C	Power:	50
Direction:	○ ↓	Duration:	Unlimited
Steering:	↔	Next Action:	

5
Wait
for
Light

Control:	Sensor	Port:	<input checked="" type="radio"/> 2
Sensor:	Light Sensor	Until:	< 50
		Function:	Generate light

ADDITIONAL INFORMATION:

Extension

Use the rotation sensor rather than the light sensor.

In the Classroom

Age level: 9+

Programming level: Inventor 4

LEGO building: Beginner

Objective: Using light sensor and loops

Materials

RCX or NXT car

Light sensor