

Bumper Cars

If you love amusement park rides, you've probably experienced the thrill of crashing, bouncing, bone rattling bumper cars! Bumper cars are a perfect example of Newton's three laws of motion. Program and play your own bumper car game and learn the science behind the crashing fun!

TEKS:

8.6C: Force, motion, and energy. The student knows that there is a relationship between force, motion, and energy. The student is expected to investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction, such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

Materials:

For building cars:

- Bumper Car Assembly Instructions (links provided below)
- Bumper Car Programming Guide (attached)
- Lego Mindstorms NXT Brick Base Set (can be found here: <https://education.lego.com/en-au/lego-education-product-database/mindstorms/9797-lego-mindstorms-education-base-set>)

For decorating cars:

- Blue or Scotch tape (avoid duct tape, masking tape, or glue – too sticky)
- Felt to cut out shapes/designs to attach to car
- Foam to cut out shapes/designs to attach to car
- Markers to draw on foam/felt
- Random Lego pieces (can be added on to base)
- Scissors

For building/decorating the ride arena:

- Glue/tape to attach pool noodle pieces around poster board
- Markers to decorate
- 4 pool noodle pieces cut to the same length as each side of the poster board (they will border the poster board to contain the ride and protect the car)
- 1 poster board (this will be the floor of the ride area)

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How To:

How to Build the Bumper Car:

1. Use this link to create your NXT bumper car.
(http://www.nxtprograms.com/castor_bot/steps.html)
2. Next, use this link to design the bumper car attachment.
(http://www.nxtprograms.com/bumper_car/steps.html)
3. Decorate your car using felt, foam, and other Lego pieces. Be careful that decorations do not interfere with the functionality of the car.

How to Program the Bumper Car:

1. Refer to attached NXT Step by Step programming instructions (provided at end of write up).
2. Make sure to test your programming and troubleshoot any issues your car may have. You want your car to collide with the obstacle (pool noodle border), move backward, turn away from the obstacle, and then keep moving forward in the new direction. Note: Your bumper is designed to trigger the touch sensor when any part of the robot hits something as it moves forward, but there are certain kinds of obstacles that it might not react to. It's also possible that the bumper will get hung up and stuck when the robot tries to back up and turn. Can you improve the design of the bumper to solve any problems you encounter?

How to Create the Bumper Car Arena:

1. Use markers to decorate one side of the poster board. This is the floor of your bumper car arena and the bumper car will move on top of it. Does your amusement park have a specific theme? Feel free to get creative with your design!
2. Using tape, attach the 4 pieces of cut pool noodle to the outside of the poster board. This will create a barrier to keep the car inside the ride arena.
3. Once your car is built, programmed, and in the decorated arena, play with your bumper car.

STEM Explanation:

All three of Newton's laws of motion are in action during the bumper car game.

Newton's 1st Law of Motion – Every object in motion continues in motion and every object at rest continues to be at rest unless an outside force acts upon it. This is called inertia. When you are riding in a bumper car and end up in a collision with another bumper car, you feel a jolt. Your body's inertia causes your body to keep moving, even though your bumper car has now suddenly stopped. The security bar or safety harness provides the force that jolts your body to a stop. Newton's 1st law of motion is the reason why it is so important to wear seat belts when riding in cars!

Newton's 2nd Law of Motion – The greater the mass of an object, the greater the force needed to change the object's motion. When riding in bumper cars, you may have noticed that people who weigh less tend to get bumped around more than people who weigh more. That's because it takes a greater force to move the cars with heavier (more mass) riders than it does to move the cars with lighter (less mass) riders.

Newton's 3rd Law of Motion – For every action, there is an equal and opposite reaction.

If two bumper cars traveling at the same speed and carrying the same amount of weight run into each other, they will bounce off and move an equal distance away from each other. However, if there is a difference in the amount of weight being carried in the two cars, the car with less weight will get bumped farther away from the point of impact than the car carrying more weight.

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Did you have trouble getting your bumper car to do what you wanted at first? If only one small detail is incorrectly programmed the car will not be able to do what you want. The computer only knows as much information as you tell it, so you must be very specific when programming your bumper car. If you could program your car to react a certain way after each collision, what would it do? Spin? Reverse? Turn? Make sounds? Flash lights? Now that you have successfully programmed your bumper car, try modifying your bumper car program to add your own ideas of what to do when the robot hits something.

Career Connection:

Physicists are scientists who research and apply the principles of physics. They study a wide range of naturally occurring physical phenomena, from the structure of tiny atomic particles to the movement of all objects within the universe, and observe patterns and develop theories that explain them. Physicists frequently combine their knowledge and skills with other disciplines like engineering, technology, and medicine.

Resources:

<http://www.hometrainingtools.com/a/amusement-park-science>

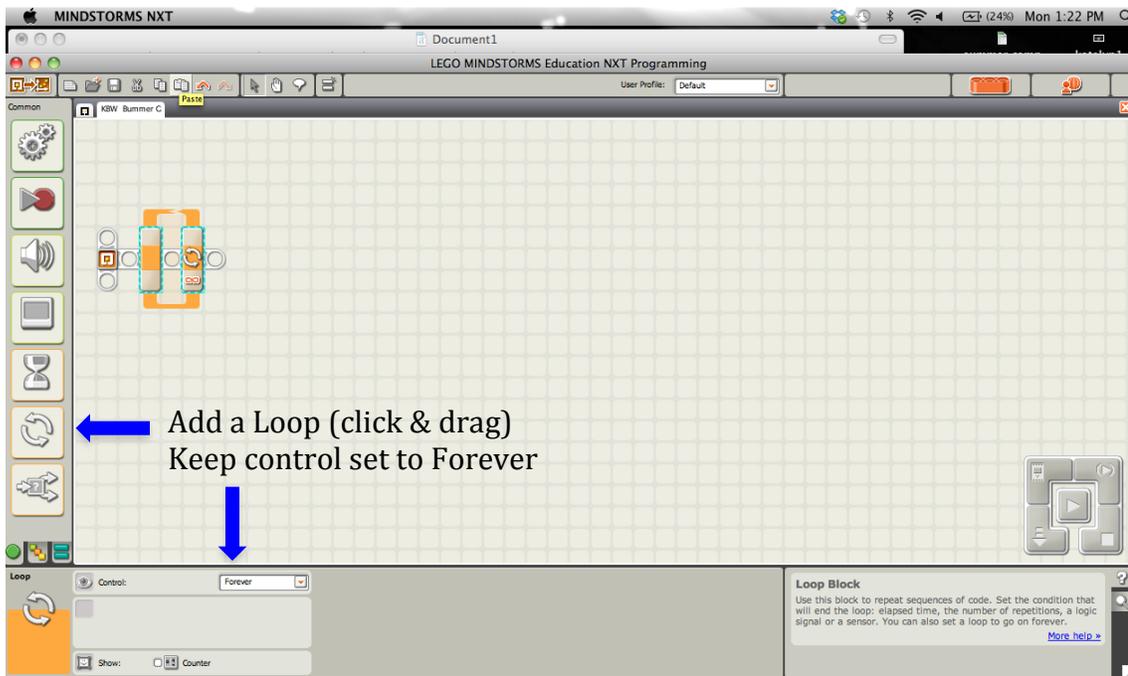
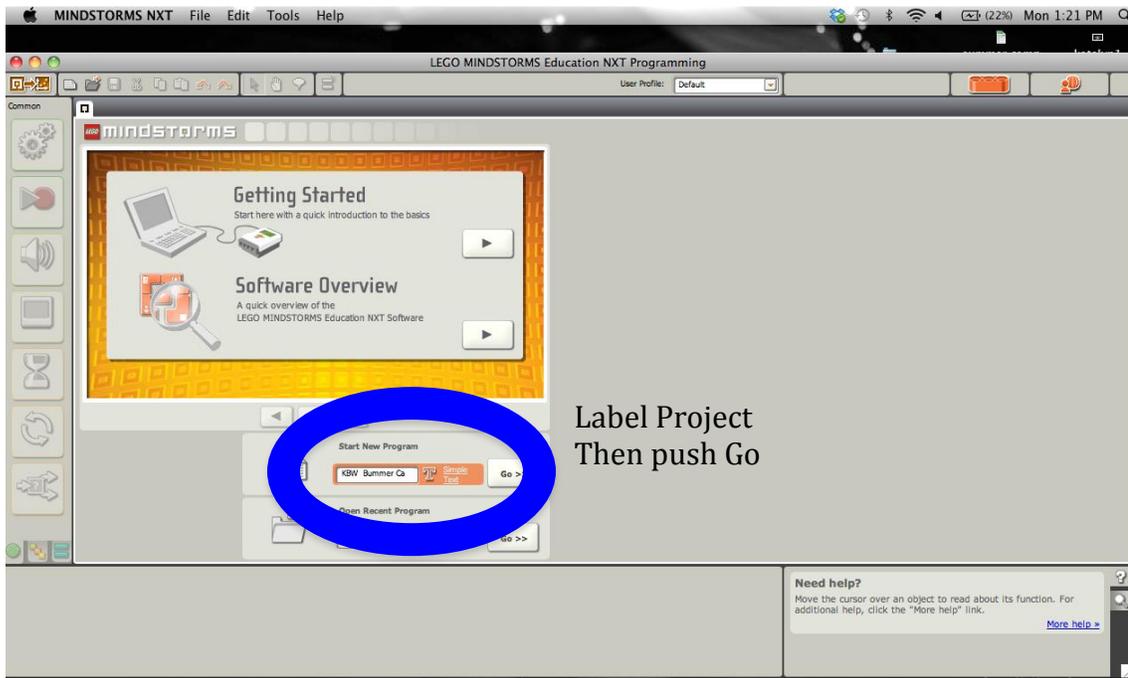
<http://www.amusementproducts.com/index.html>

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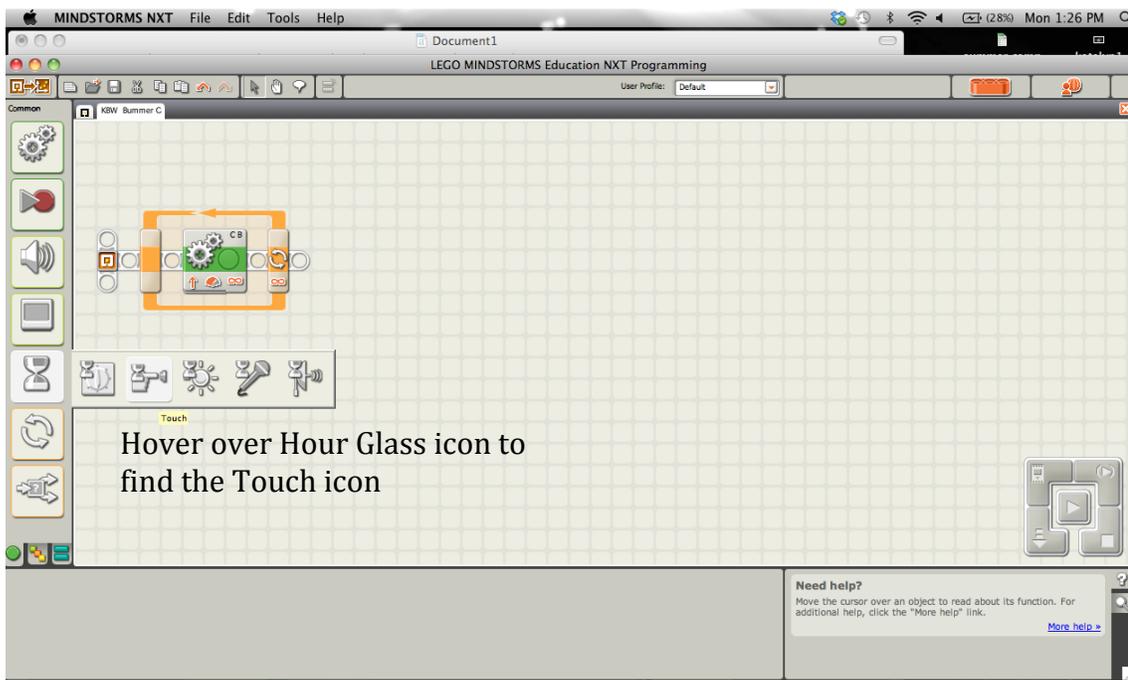
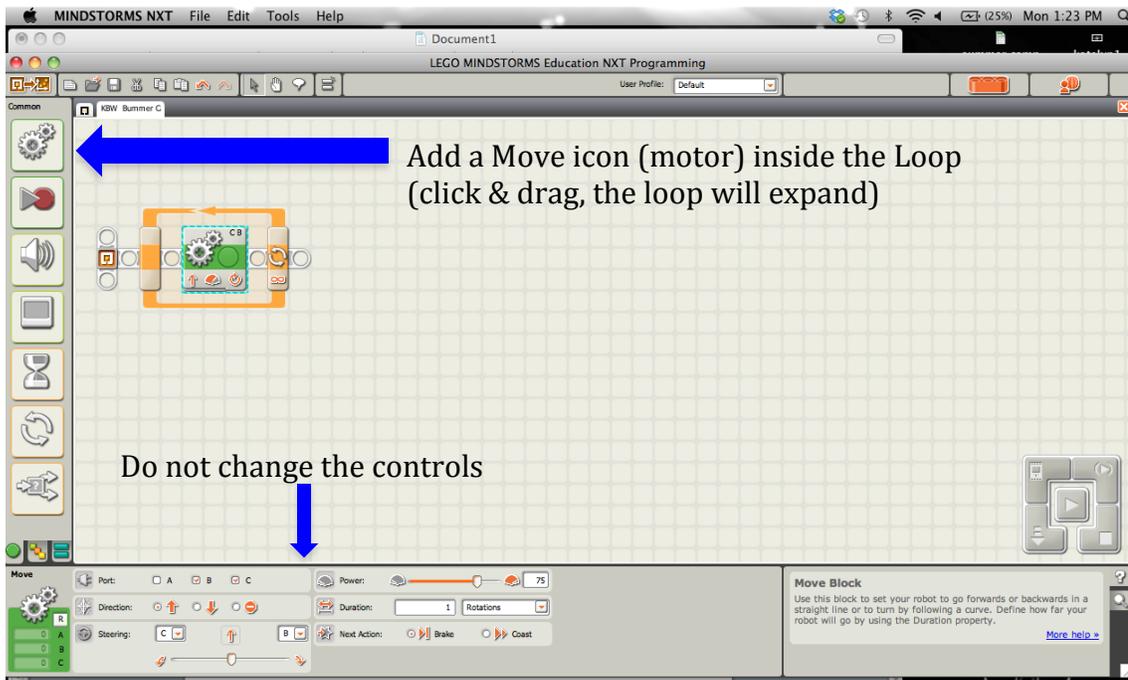
NXT Bumper Car Programming Guide



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Document1
LEGO MINDSTORMS Education NXT Programming
User Profile: Default

Common
KBW Bummer C

Add the Touch icon inside the Loop
(click & drag, the loop will expand)

Sequence Beam
The sequence beam controls the flow of your program. Blocks connected to the sequence beam can be downloaded to the NXT; unconnected blocks cannot. Create a parallel sequence beam by moving the mouse pointer over the starting point (or over the wire stub), and pressing and holding your mouse button while you move the mouse upwards or downwards.
[More help >](#)

Document1
LEGO MINDSTORMS Education NXT Programming
User Profile: Default

Common
KBW Bummer C

Add a Move icon (motor) inside the Loop
(click & drag, the loop will expand)

1. Change Direction to Backwards
2. Change Duration to Seconds (each group will need to test how many seconds they want)

Move
Port: A B C
Power: 75
Direction: Backwards
Duration: 1 Seconds
Steering: C
Next Action: Brake Coast

Move Block
Use this block to set your robot to go forwards or backwards in a straight line or to turn by following a curve. Define how far your robot will go by using the Duration property.
[More help >](#)

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MINDSTORMS NXT File Edit Tools Help Document1 LEGO MINDSTORMS Education NXT Programming User Profile: Default

Common K8W Bumper C

← Add a Move icon (motor) inside the Loop (click & drag, the loop will expand)

1. Move Steering all the way right
2. Change Duration to Degrees

Move Block
Use this block to set your robot to go forwards or backwards in a straight line or to turn by following a curve. Define how far your robot will go by using the Duration property. [More help >](#)

MINDSTORMS NXT File Edit Tools Help Document1 LEGO MINDSTORMS Education NXT Programming User Profile: Default

Common K8W Bumper C

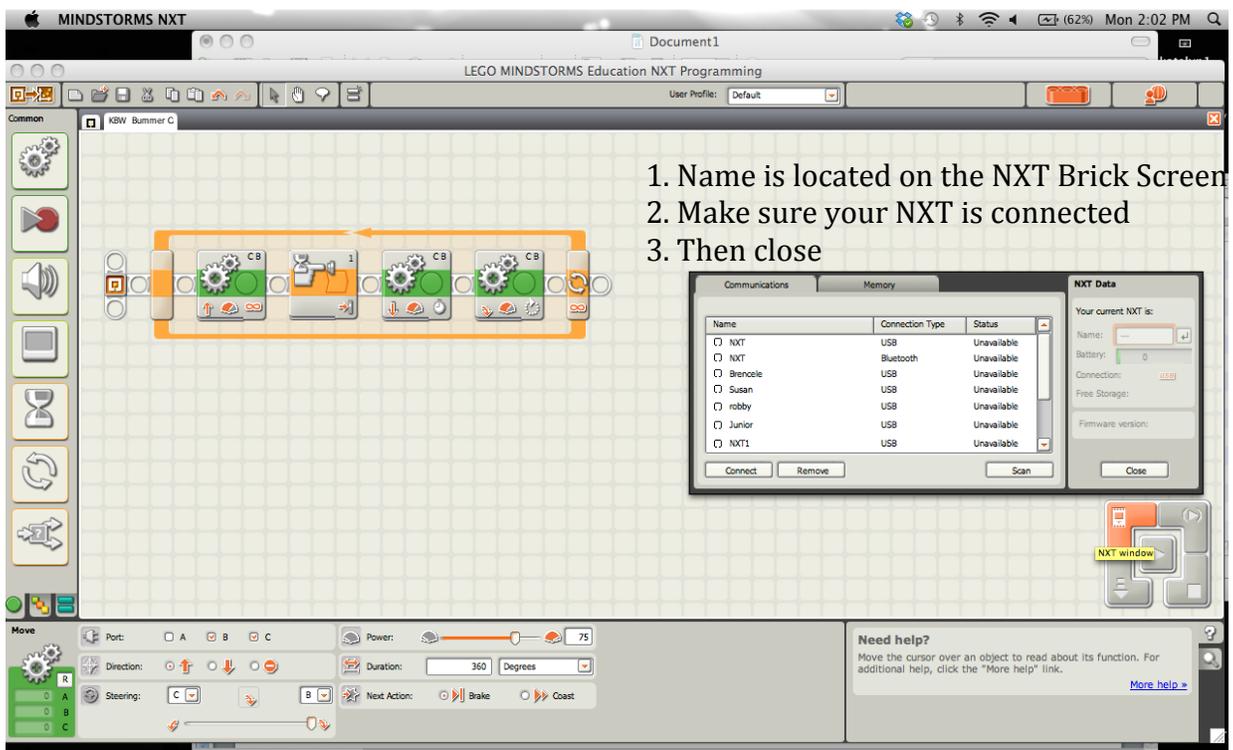
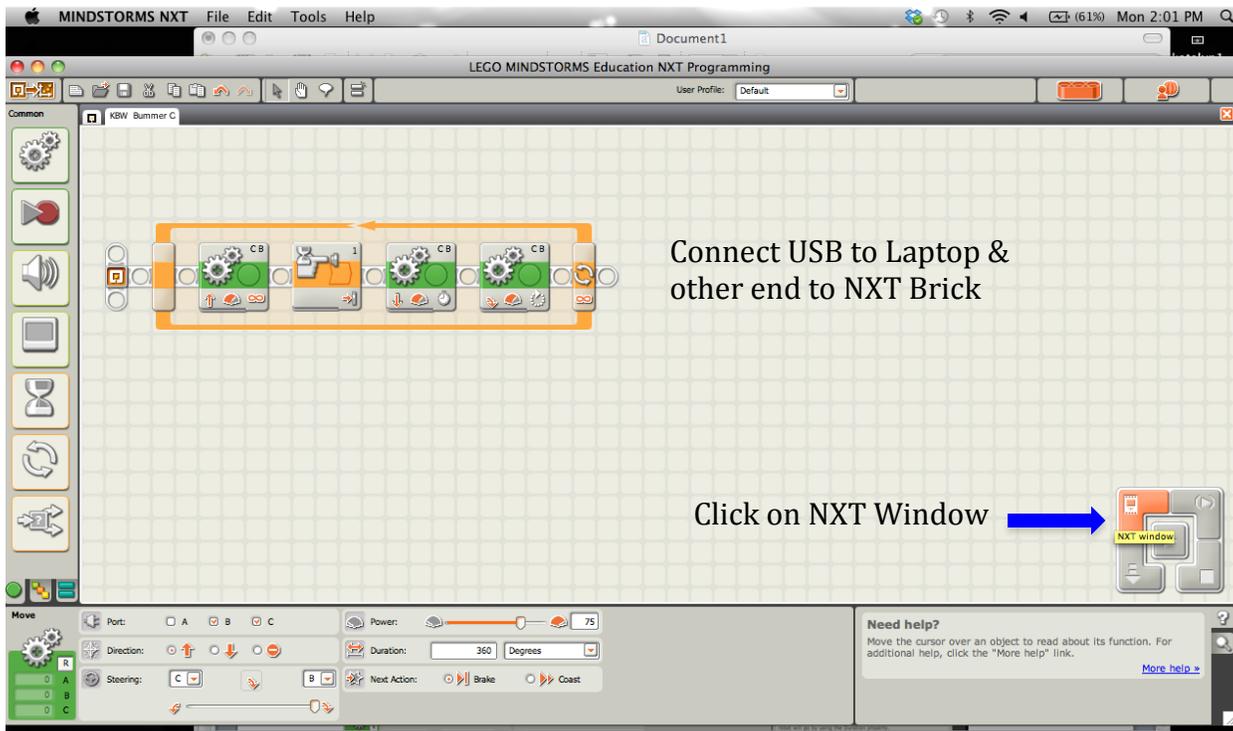
SAVE

Move Block
Use this block to set your robot to go forwards or backwards in a straight line or to turn by following a curve. Define how far your robot will go by using the Duration property. [More help >](#)

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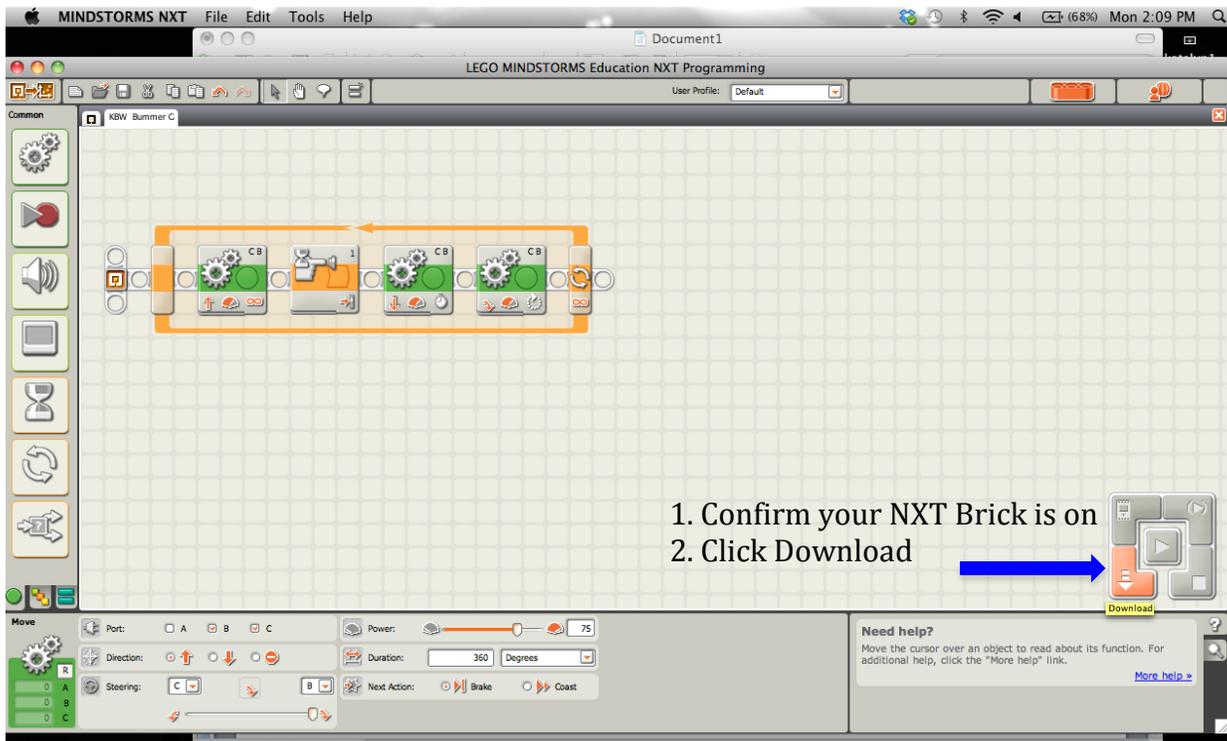
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1. Confirm your NXT Brick is on
2. Click Download

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