



# Forces and Springs

Exemplar Lesson

# Learn

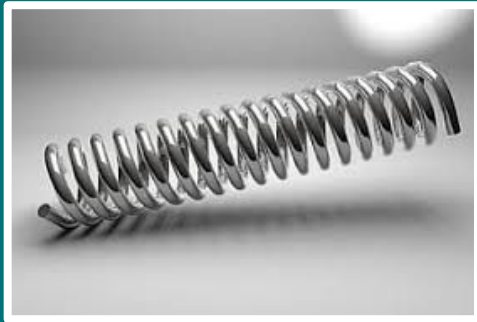
# Key Information



- Springs can be used to keep an object in place or return to a previous position, like a spring in a pen.
- Springs can be tightly coiled or expanded when at rest.

# Unplugged Activity

## What factors affects the stiffness of a spring?



If you increase:

1. Length
2. Diameter of coil
3. Size of wire
4. Number of coils per inch

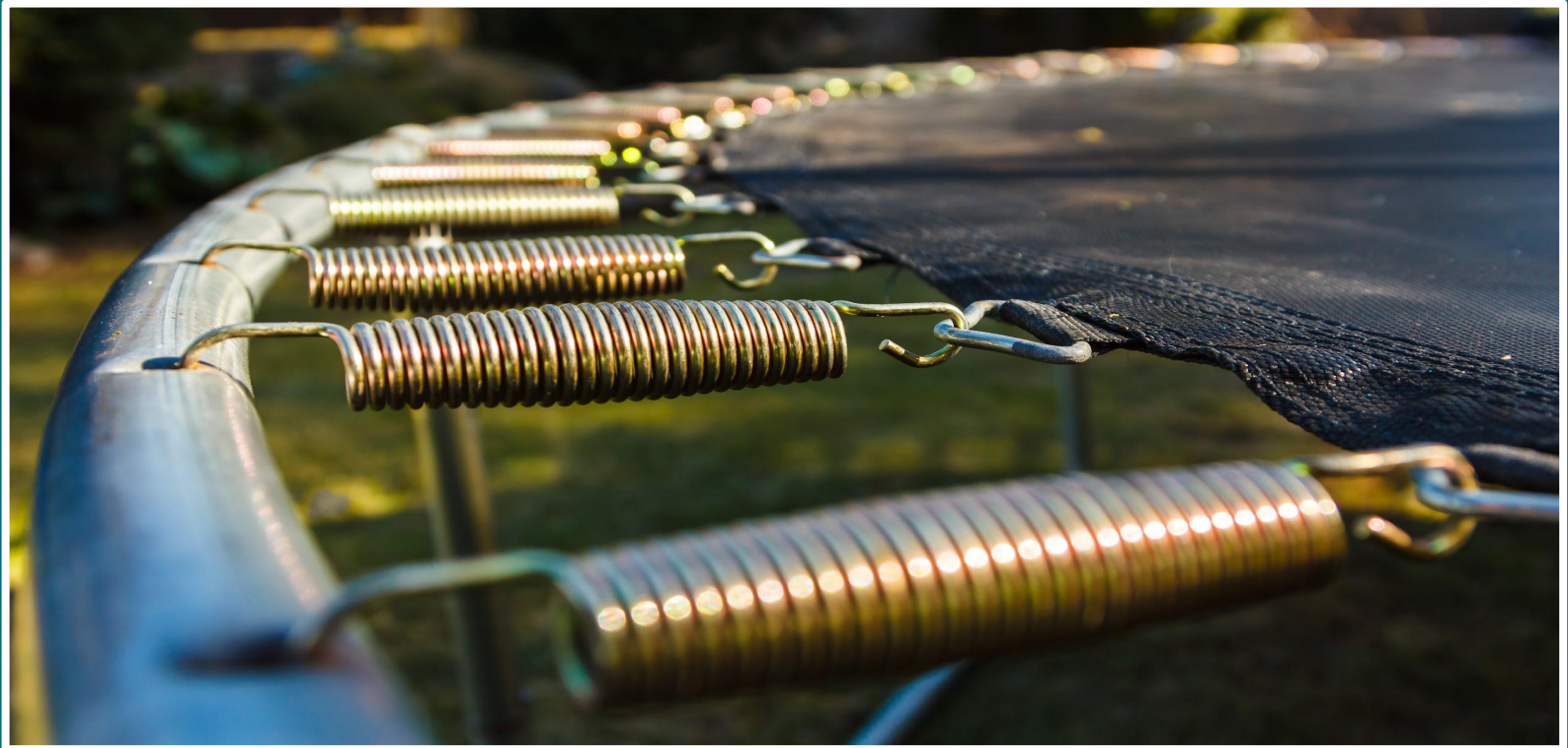
Does the spring become:

- ☐ More stiff
- ☐ Less stiff
- ☐ No change in stiffness

Does the type of material matter?

# Unplugged Activity

## Where do you find springs in our everyday lives?



What springs can you find around you?



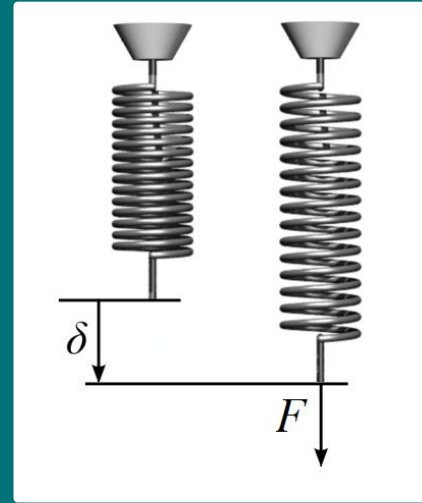
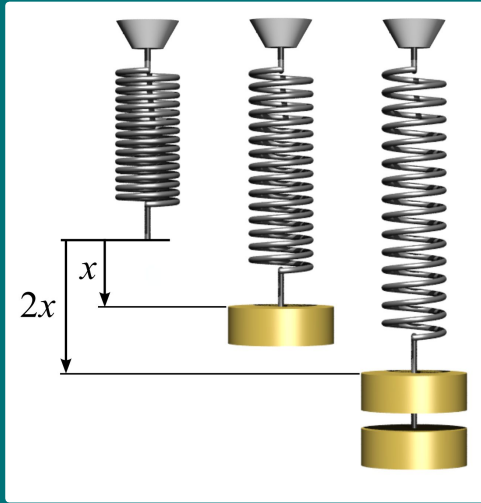
## Complete a KWL chart to record your knowledge

## Date \_\_\_\_\_

<b>Know</b>	<b>Wonder</b>	<b>Learned</b>
<p>What do you think you already know about this topic?</p>	<p>What do you wonder about this topic? Write your questions below.</p>	<p>After you complete your project, write what you learned.</p>

## Key Information

# What is the relationship between the force and the spring as it is stretched?



- Springs are **elastic**, allowing them to stretch.
- Springs return to their original shape/position when **no forces** are applied.
- You can permanently change the structure of the material by applying **too large** a force.

# Unplugged Activity



Can you guess which spring is harder to stretch just by looking at it?

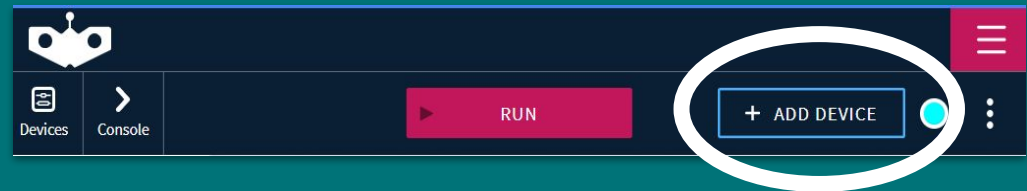


# Do

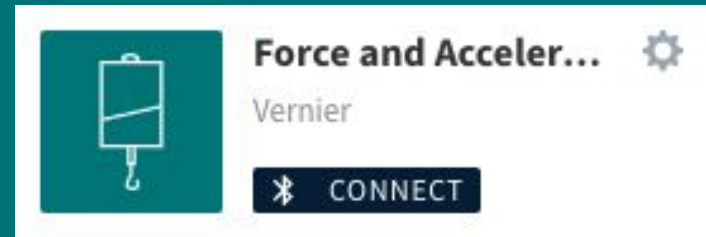
Guided Lab - Part 1

## Design and code a program that measures the the force applied to a spring

**A** Go to <https://edu.workbencheducation.com/>

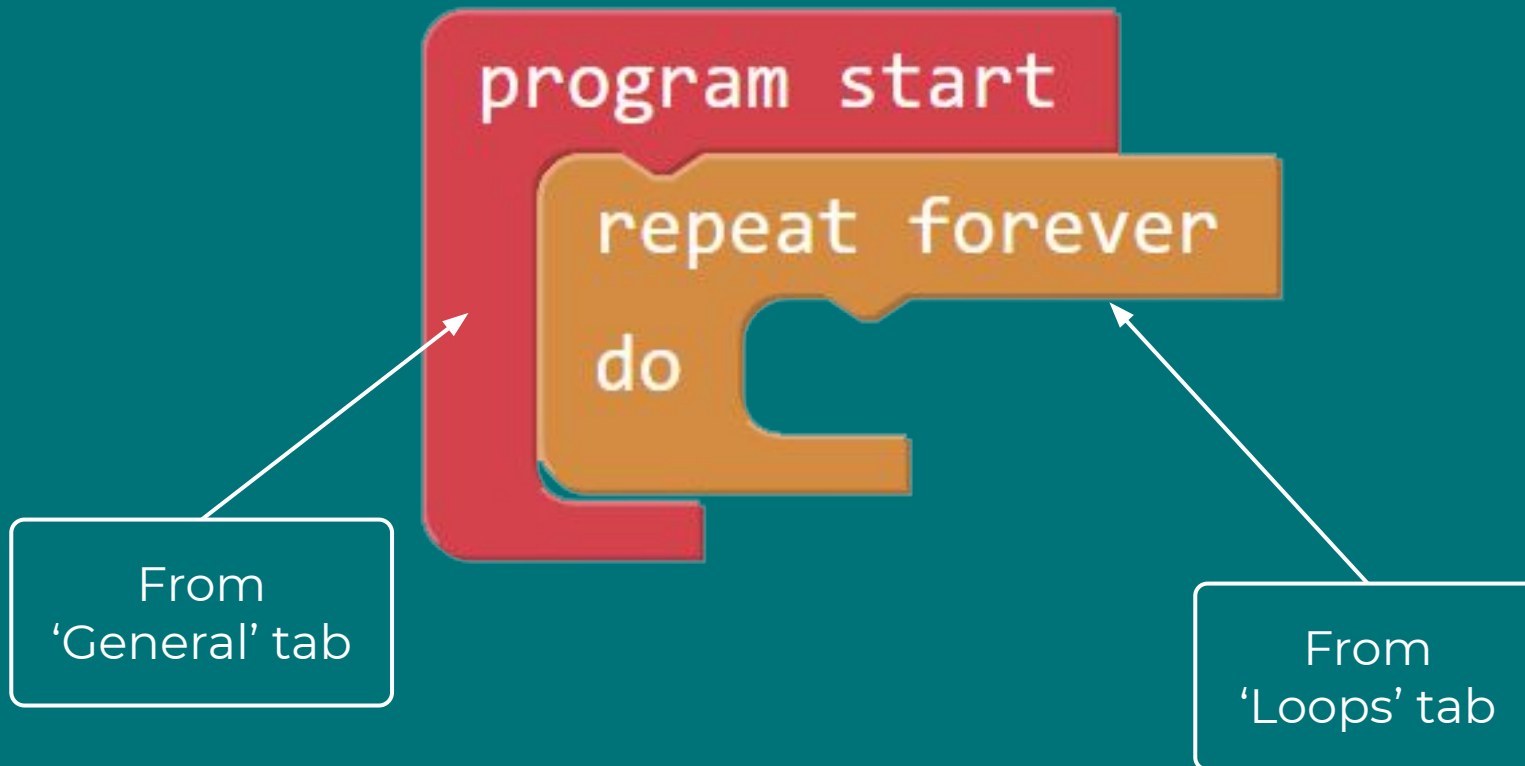


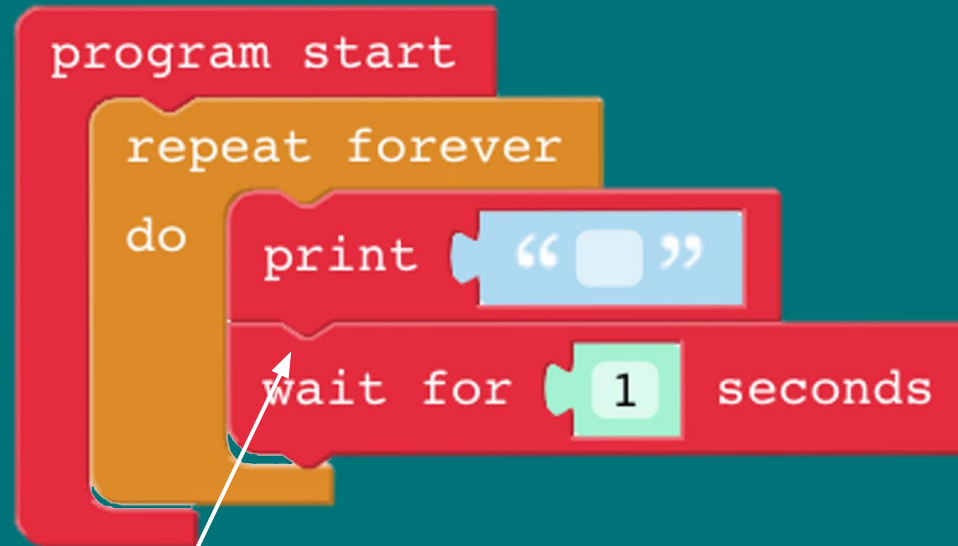
**B** On the Workspace click 'ADD DEVICE' and select: 'Force and Acceleration Sensor'



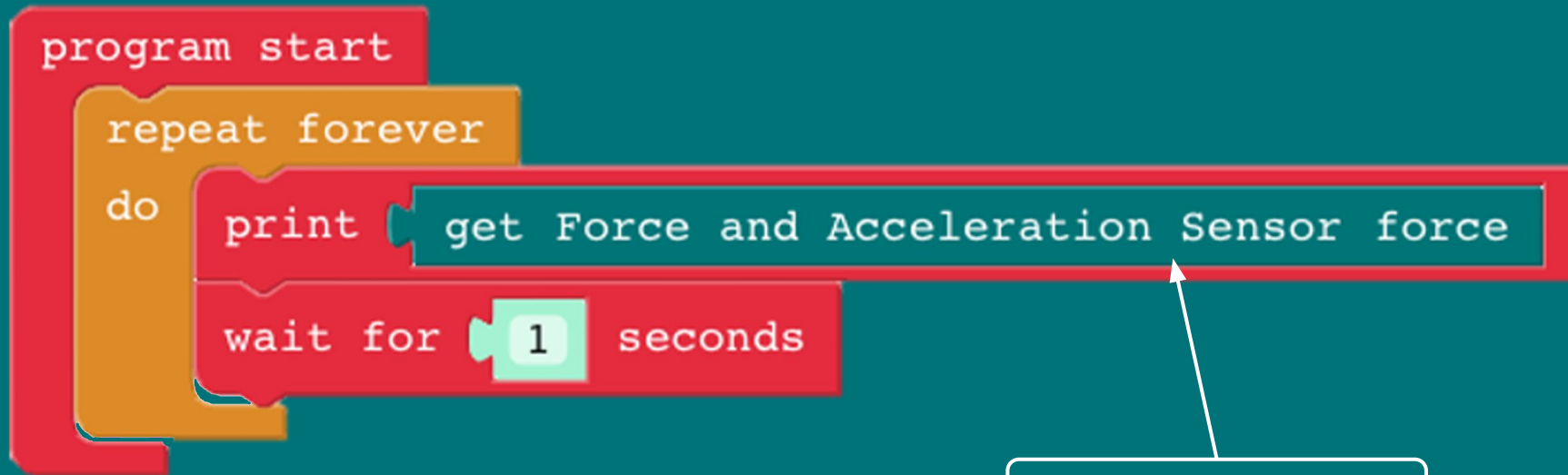
**C** Connect the Force and Acceleration Sensor, click 'CONNECT' and 'Pair'.

# Guided Lab - Part 1





From  
'General' tab



From 'Force and Acceleration' tab



# Run your program

What do your results look like?



The screenshot shows a software interface with a dark blue header. On the left, there are two tabs: 'Devices' with a USB icon and 'Console' with a right-pointing arrow icon. The 'Console' tab is selected and highlighted with a red arrow pointing down to the data area. The data area is a light gray rectangle containing a list of seven numerical values, each on a separate line with a horizontal line to its right.

Devices	Console
	0.12
	4.23
	2.17
	0.14
	0.31
	-0.48

# Construction Activity

Build a meter that  
displays force.

# Construction Activity

## Explore how to control the Servo Motor

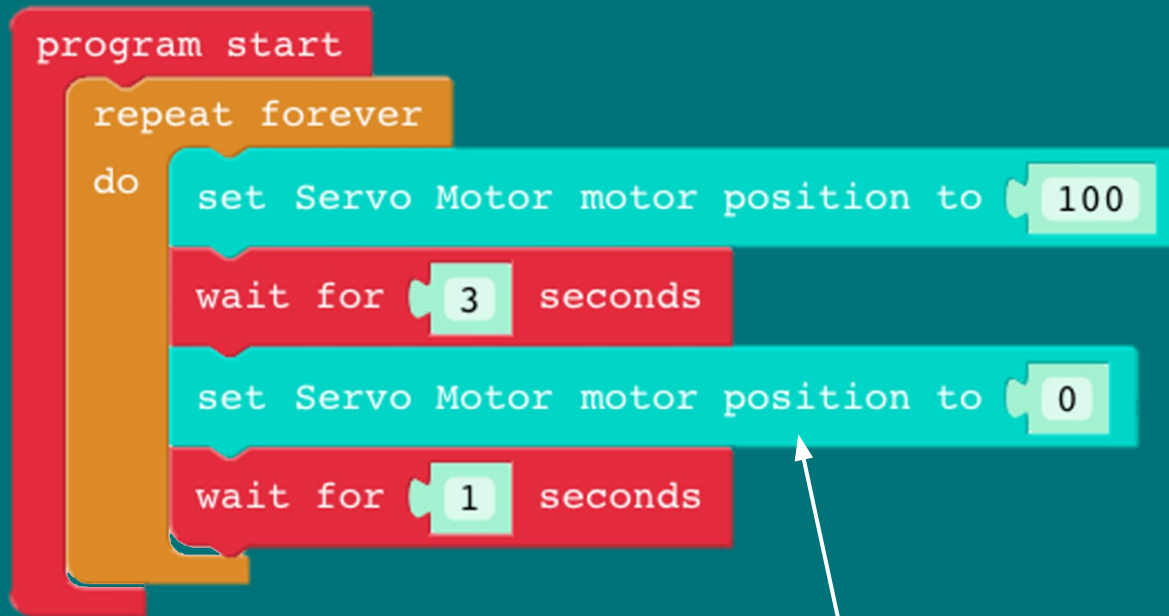
Add Device  
Select Servo Motor



Connect the Servo  
Motor, click  
'CONNECT' and  
'Pair'.



# Construction Activity



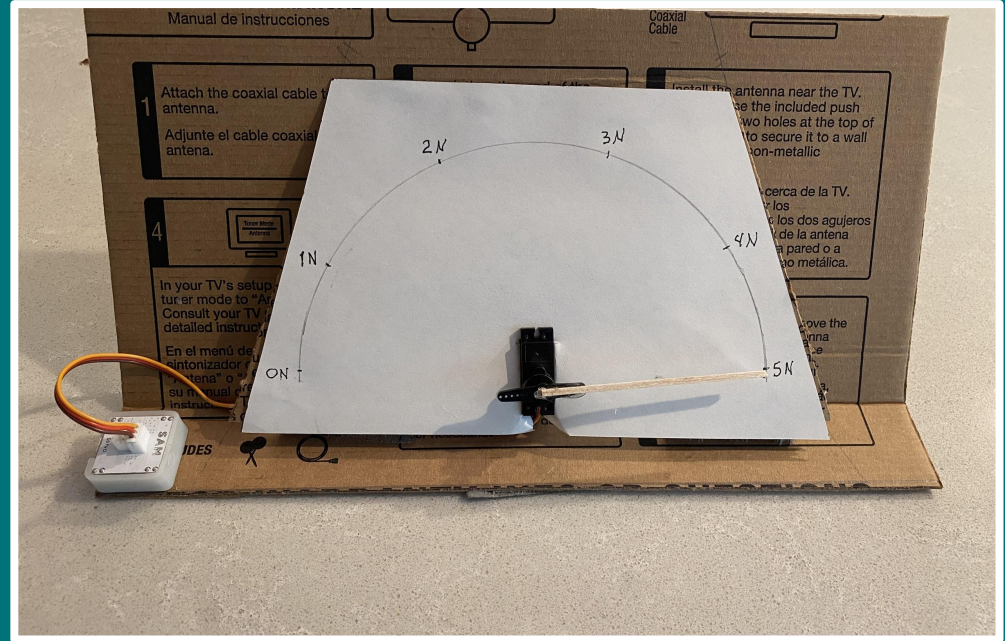
From 'Servo  
Motor' tab

Can you modify the force values to change the position of the Servo Motor?

# Construction Activity

Build a meter to display force using:

- Servo Motor block
- Cardboard
- Paper
- Tape
- Pen or marker



Where does your Servo Motor point when it is at “0”?

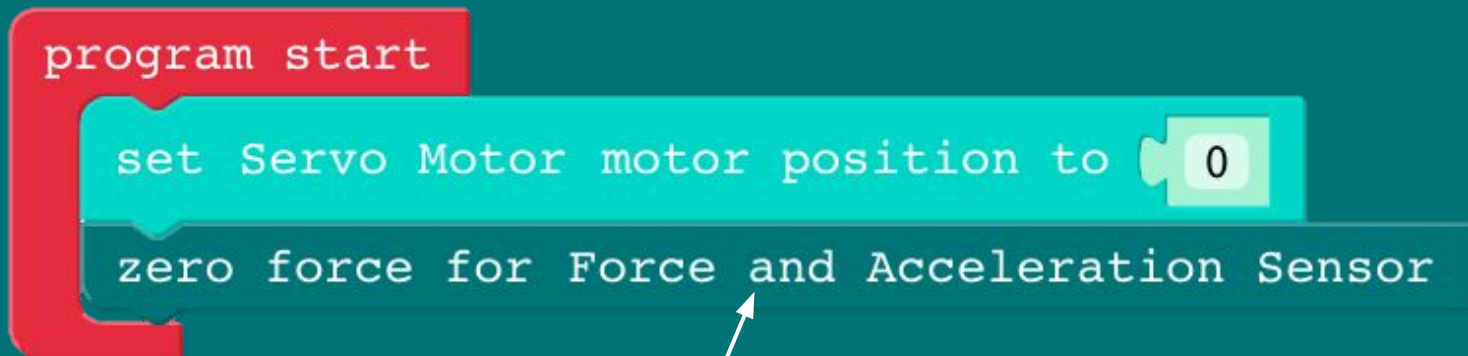


# Do

Guided Lab - Part 2

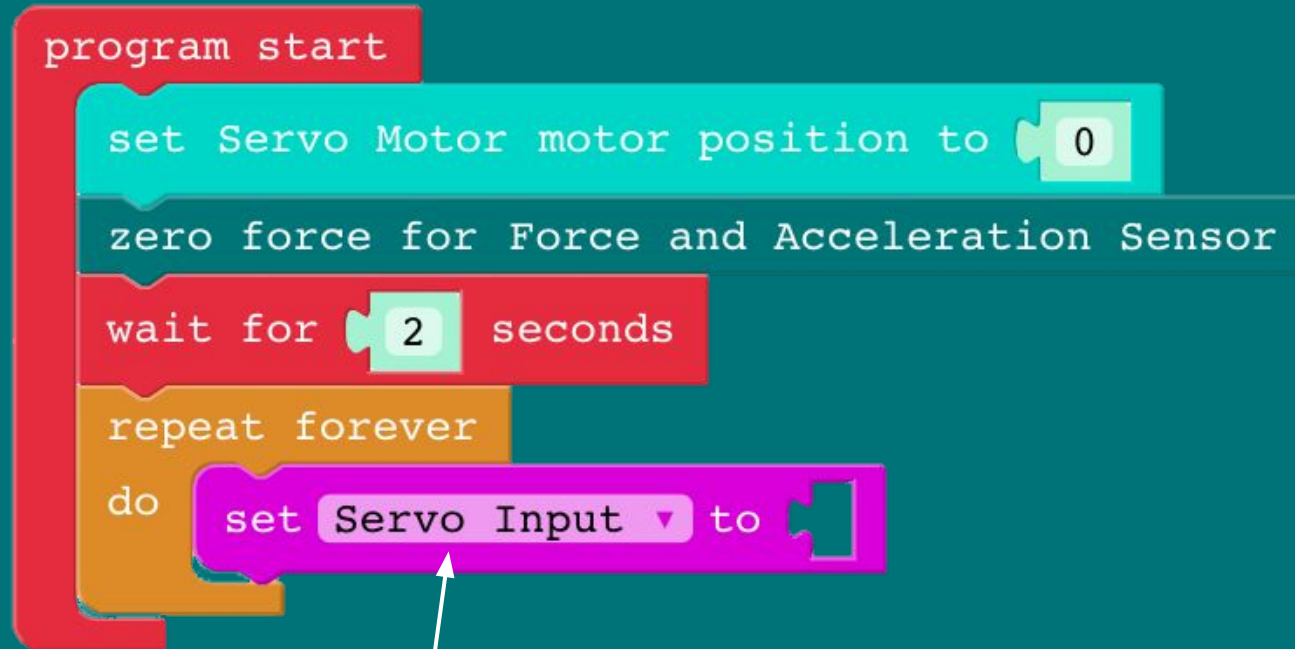
# Guided Lab - Part 2

**Design and code a program that will use the data from the Force and Acceleration Sensor to control the position of the Servo Motor.**



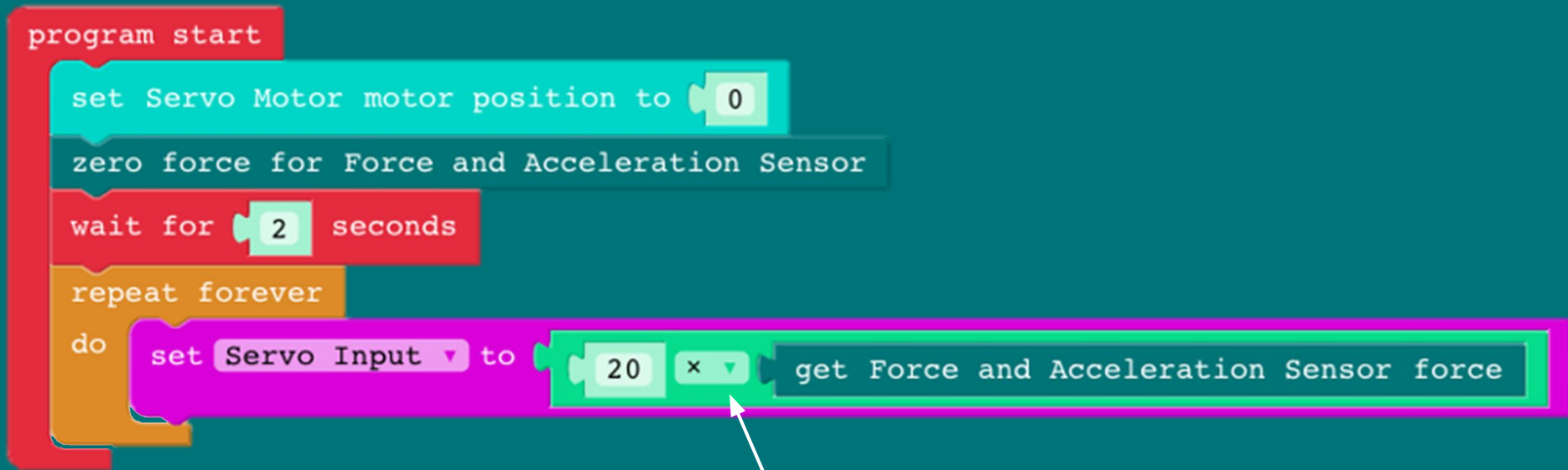
From  
'Force and  
Acceleration'  
tab

# Guided Lab - Part 2



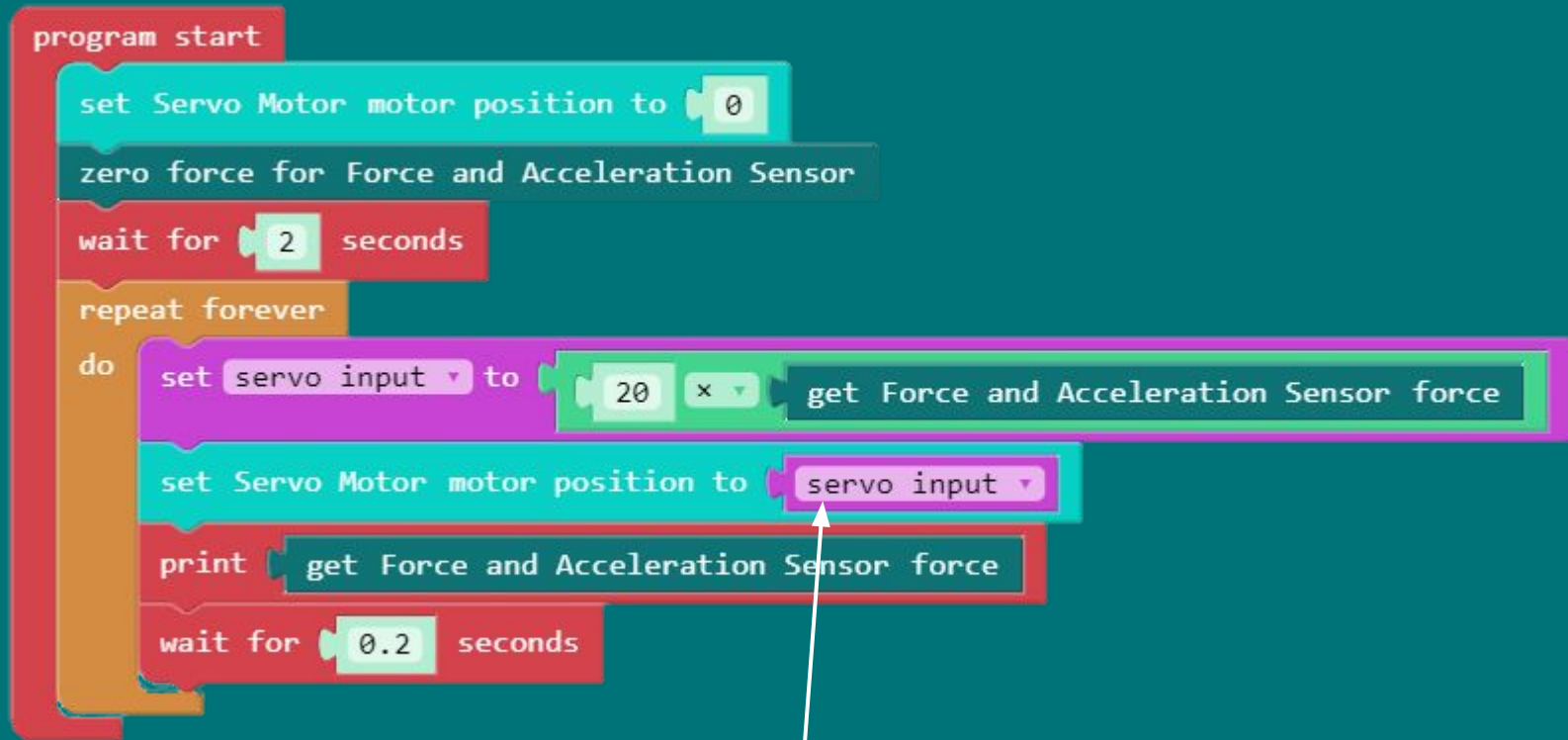
From 'Variables' tab  
Create 'Servo Input'  
variable

# Guided Lab - Part 2



From 'Math' tab

# Guided Lab - Part 2



From 'Variables' tab



# Extension Activities

## Extension 1

Clockwise

Modify the code to reflect the meter moving clockwise rather than counterclockwise when displaying the data of the Force and Acceleration Sensor.

## Extension 2

Force and Distance

Design and code a program that collects force data and allows you to manually enter the distance the spring is stretched.

## Extension 3

Spring Constant

Design and code a program that collects force data, inputs spring stretch distance, and calculates the spring constant.

# Reflect

# Exit Tickets



**What are three of the factors that affect the stiffness of a spring?**

**What is one thing you could do to improve your meter? Explain what you would do.**