VARIABLE ADVENTURES QUEST!

Let's make some changes to the code…change the variable of speed.
Draw the block with the variable that you modified:

What will you do to prove that the Buggy's speed increased?

_____

Now change the variable of LED color.
Draw the block with the variable that you modified:

Which color will light up on the Buggy now? _____
Run your test! What happened?

_____

Now change the variable of direction.
Draw the block with the variable that you modified:

How does the Buggy move now? _____

MIX IT UP QUEST!

Look at the "mixed up" order in the chart below:

1. Light LED to **yellow**	2. Right turn for **7** seconds	3. Run straight for **6** seconds

➔ Change the sequence of the script using mDesigner so that the Buggy performs all three functions in the order shown. Add a WAIT block of 3 seconds between each block command. Then change the value of the variables shown in **bold.**

Predict It!
How will your new script run the Buggy?

_____

_____

Create your own code quest!

With what you know so far, create a block code stack to exercise all aspects of the Buggy by including the following in any order that you choose:

- Make sound (buzzer)
- Make a higher pitch sound (buzzer)
- Light (make the two LED lights various colors)
- Make the Buggy pause for 2 seconds between some of your steps
- Move the Buggy in 4 ways…
    - Forward
    - Backward
    - Turn left
    - Turn right
    - Spin in one spot

Prove it by putting all your block code steps into a single program script.

Does coding make you a better problem solver? _____

If you feel coding does make you a better problem solver, would this skill apply only to block coding? _____

Explain your answer _____
_____
_____
_____
_____


Chime Time!

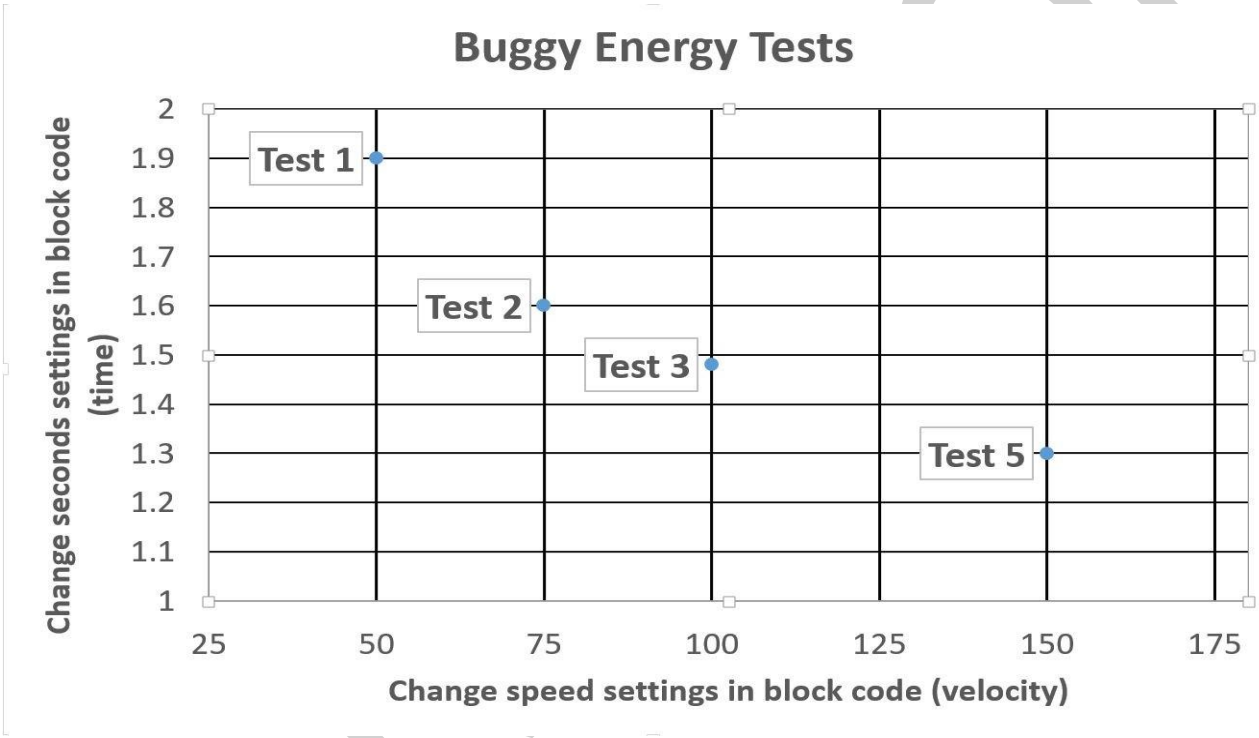
Student Name_____ Date _____

Session 7:

THE BIG PLOT QUEST!

Analyze It!

Look at the EXAMPLE test points in the chart below:

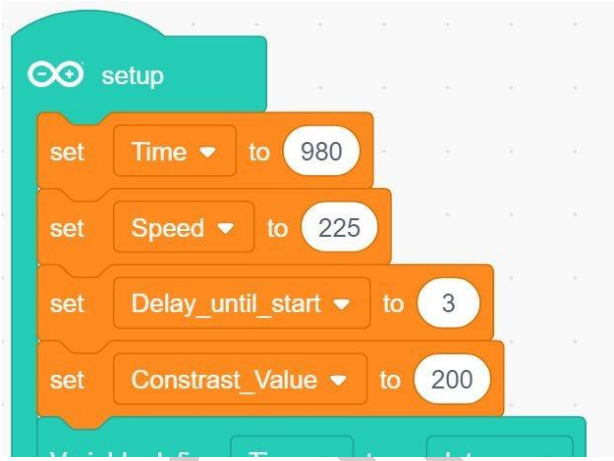


Visualize It!

In this session we are going to run the Buggy at different speed and time settings so that it will begin at the *same start point* and then stop *at the same endpoint*. Each Buggy has its own speeds and time so we will now run a series of tests to make your chart similar to the one above. Once we do that we will also make a prediction for the missing Test 4 in our chart.

Now, Let's set this up!

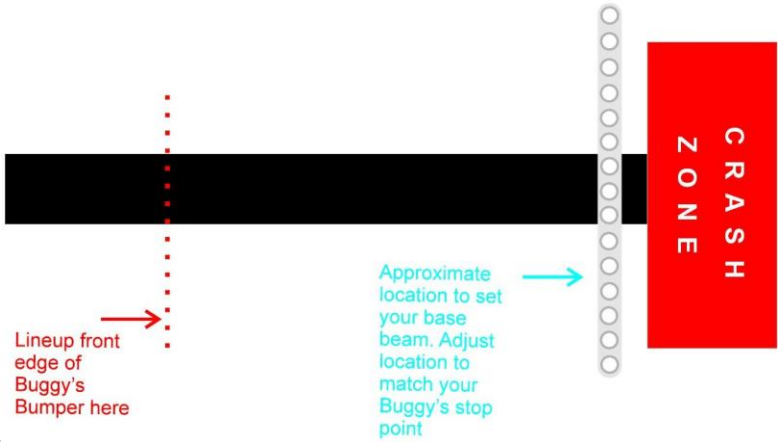
First, set the code!



Open the file **'IBB speed-time chart.mdx**' in mDesigner application. This code uses the line tracing ability of Buggy to keep it on the wide line of your 'test track' sheet. The only variables we will modify are the '**Speed**' and '**Time**' settings at the top of the block code script (see below). These will change how fast and how long the Buggy will run. Start with the settings above. Note that the '**Time**' is in Milliseconds. 980ms = 0.980 of a second!

Second, setup the test track!

The **test track page** to run the Buggy looks like this page (see below). Program the 'Time' and 'Speed' settings of the Buggy for your first trail run. Turn on the Buggy's power and line the front of the Buggy up with the left side of red dotted line. Turn on the Buggy, you have 3 seconds to line it up on the dotted red line on the left side of the page. The Buggy will then move from left to right at stop at some point before the 'CRASH ZONE'. [If you want more than 3 seconds to line up your Buggy you can increase the delay by increasing the variable code setting of '**Delay_until_start_Running**' to the number of seconds you wish]. After the Buggy stops, make a mark on the test track page where the FRONT of the Buggy stopped.



Think It!

What 2 variables will you be changing to make the Buggy stop at the same place as it did on your first run?

Variable 1_____Why? _____

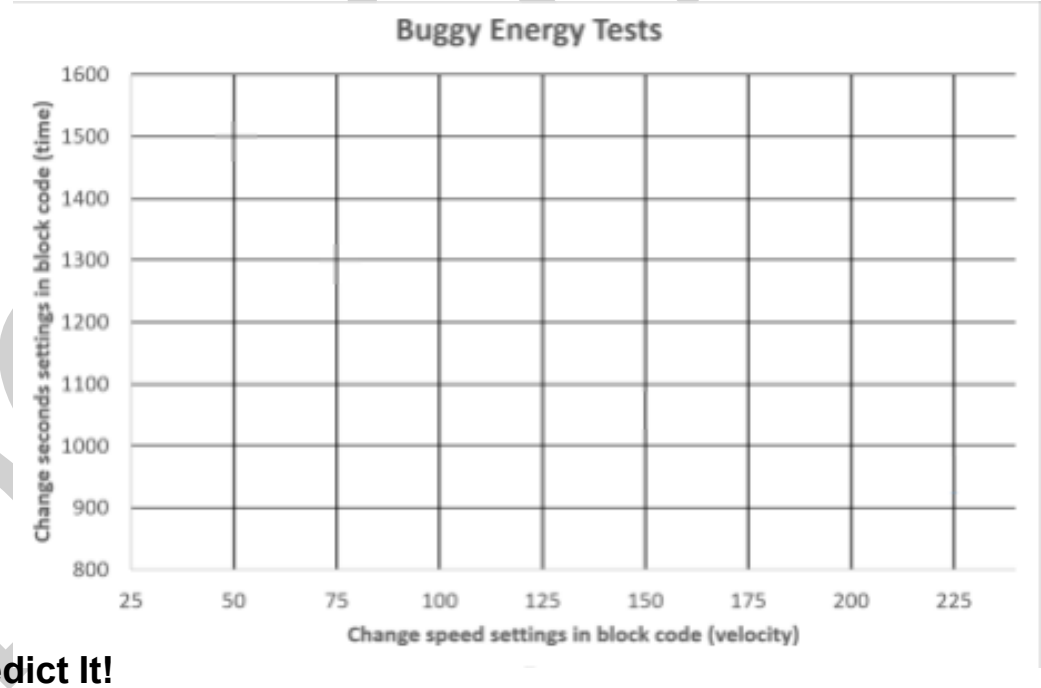
Variable 2_____Why?_____

Now using trial and retrial method, program your '**Speed**' settings for each test, shown below, until you find the time so the Buggy stops at the same end point as before and enter your 'Time' setting:

	'**Speed**' setting	'**Time**' setting
Test 1?	50	_____ms
Test **2**?	75	_____ms
Test **3**?	150	_____ms
Test **5**?	225	980 ms

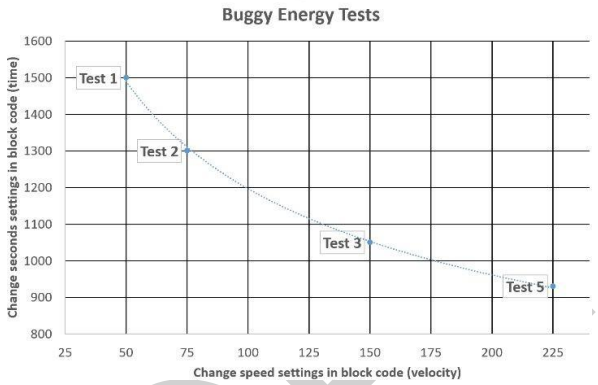
Now, copy these variables into the chart on page 37

Plot your Test point results in the chart below:



Predict It!

Predict where the missing **Test 4 point** at **Speed 175** would be between test plot 3 and test plot 5 based on your trials and the graph data given? To help do this sketch a line or curve on your chart above that seem to connect your Test Point data like the example chart to the right:



Test 4 point will be _____

Explain it!

_____

_____

Run It!
What happened? _____
Was your prediction close to the actual results? _____

Can you now plot additional Test Points for speeds between 50 -225? _____
PLOT IT! Explain Why. _____

And the Question is...
Why does it take more time for the Buggy to gain speed between Test points 1-2 than test point 2 - 5?
Our thinking is _____

_____

_____

Research It! (Use the Internet)
Site(s) we used in our research: _____

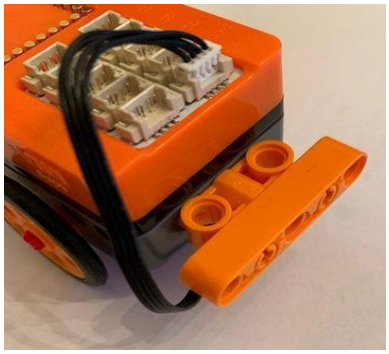
We discovered....

Does it take more or less rotations of the wheels to get from the **Start Point** to the **End point** based on higher or lower speeds you tested? _____

Explain _____

Student Name_____ Date _____

Sessions 8 and 9



Test It!

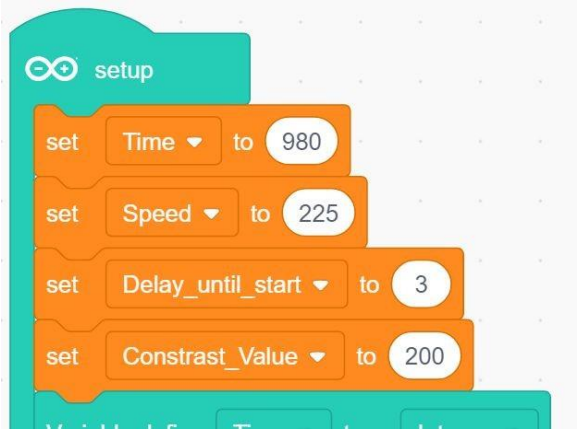
BUMP IT UP QUEST!
For this next quest let's add a little bumper to the Buggy. Find the two pieces and add them to your Buggy as you see in the photo.

Sketch It!

Piece 1	Piece 2

"Brick by Brick" Quest!

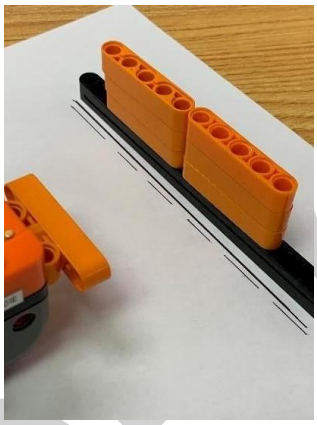
Open the **'IBB speed-time chart.md3'** in mDesigner application. Use the same Buggy you used in the previous session so that we use the same **Speed** and **Time** data for the same Buggy.



Test It!

Program It!

Program your Buggy using any one of the **Speed** and **Time** (duration) settings from your previous test chart on Page 37.



Build It!

On the Test Track Page we used in the previous session put a new, dashed line ½ cm to the left of where the Buggy stops. (just a little closer to the red dotted start line). See top photo at right.

Stack a 'brick' wall with your other Buggy building block pieces (using the long 15-hole black beam on the bottom and 2 sets of, side-by-side, of 3 high, 5-hole orange pieces) as you see in the pictures to the right. **Keep them loose**. *Do not connect the pieces together*.

Place It!

Place the 'brick' wall at the dashed line you marked in the previous step. (see the lower picture to the right).

Move It!

Is the wall 'at rest' prior to the Buggy going into the 'brick' wall?

_____

Does the 'brick' wall have any speed or acceleration (is it moving?) prior to the Buggy going into the 'brick' wall? _____

What is going to happen to the 'brick' wall when hit by the Buggy?

_____

Our Thinking:

_____

_____

Chime Time!
Which test will yield the most amount of bricks falling?
Test and Provide evidence with pictures with your device!
Code the Buggy using the speed and seconds of Test Point 1 from the graph.
Put your Buggy on the start line and turn it on.

This will cause the Buggy to ‘crash” into the ‘brick’ block wall! How far did the ‘brick’ blocks move? Under **OTHER OBSERVATIONS** write whether the wall accelerated (A) or (NA) no acceleration. Acceleration simply means that the wall’s speed **changed** from when it was at rest before the Buggy impacted it. Fill in your observations under Trial #1 below.

TRIAL #	SPEED	TIME	# FALLEN PIECES	OTHER OBSERVATIONS
1				
2				
3				
5				
PREDICTION TRIAL!				
4				

Test and Record with pictures again!
Re-build your ‘brick’ wall so it is the same as it was in experiment 1.
Now change the speed to increase the value by 25.
The speed is now _____

Reprogram the Buggy using the speed and seconds of Test Point #2 on the graph . “Crash” the Buggy into the ‘brick’ wall. How many ‘bricks’ fell? _____

Record It!

Record all data for Test Point #2 in chart above.
Also record under OTHER OBSERVATIONS using an A for acceleration of wall, NA for no acceleration.
From when it was at rest, can you detect a pattern? If yes, what is the pattern?

_____

Build It!

Re-build your wall so it is the same as it was in experiment 2.
Now change the speed to increase the value by 25. (Test Point#3)
The speed is now _____
Reprogram the Buggy using the speed and seconds of Test Point #3 on the graph.
"Crash" the Buggy into the 'brick' wall. How many 'bricks' fell? _____

Record It Again!

Record all data for experiment #3 in chart above.
Also record under OTHER OBSERVATIONS using an A for acceleration of wall, NA for no acceleration.
From when it was at rest, can you detect a pattern? If yes, what is the pattern?

_____

Build It Again!

Re-build your 'brick' wall so it is the same as it was in experiment Test Trial #3.
Now change the speed to increase the value by 25. (Trial #5)
The speed is now _____
Reprogram the Buggy using the speed and seconds of Test Point #5 on the graph . "Crash" the Buggy into the 'brick' wall. How many 'bricks' fell?

Record It Again!

Record all data for experiment for Test Point #5 in the chart above.
In OTHER OBSERVATIONS using an A - wall acceleration, NA no acceleration.

From when it was at rest, can you detect a pattern? _____

Build It Again!

Re-build your 'brick' wall so it is the same as it was in experiment Test Trial #5.
Now change the speed to increase the value by 25. (Test Point #4)
The speed is now_____.
Re-program the Buggy using the speed & seconds of your prediction for Test Point #4 on graph. "Crash" the Buggy into the 'brick' wall.
How many 'bricks' fell? _____

Record It Again!

Record all data for trial #3 in chart above.
Also record under OTHER OBSERVATIONS using an A for acceleration of wall, NA for no acceleration.
From when it was at rest, can you detect a pattern? _____

Use the following questions to answer the two statements below:

- ➔Did the bricks fall at different distances each time?
- ➔Analyze your trials and your photos. What do you notice about the bricks?
- ➔Was the wall at rest or not at rest during your trials?
- ➔How did the bricks move if the buggy was at rest on impact when it hit the wall?

Analyze It!

Based on your Buggy tests with the 'brick' wall experiments, do you agree or disagree with the statements below? Use the data you have collected.

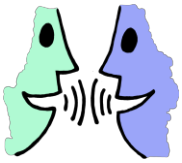
1: *The faster a given object is moving, the more energy it possesses.*

Statement 1: Agree or Disagree _____
Supportive Evidence:

2: *When objects collide, energy can be transferred from one object to another*

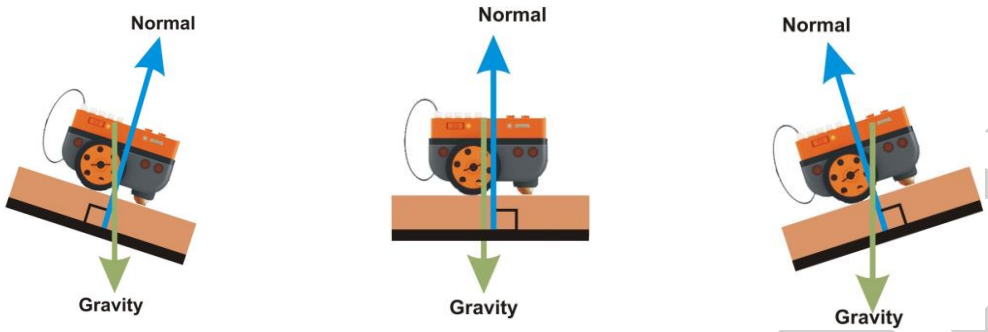
Statement 2: Agree or Disagree _____

Supportive Evidence:

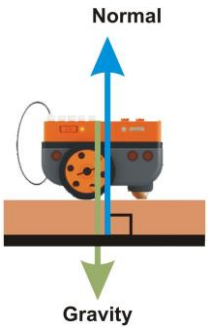


Chime Time! Provide evidence to support the two statements above.

MAY THE FORCE BE WITH YOU! A force is a *PUSH* or a *PULL* on an object.



There are two forces that are acting upon each other in these diagrams.
One is gravity and the other is called normal force.
Analyze how these two forces can act upon each other and the buggy in the diagrams above. Then let's talk about these two forces!



Reflect On It!

Circle the diagram above that shows the forces are balanced.
Explain your idea:

_____

Which force, if not there, would have the table falling down to the center of the earth? (Put a triangle around it) first, second or third diagram?
And the winner is …_____Explain your idea:

_____

Which force, if not there, would have table floating up off the floor?
And the winner is ...._____Explain your idea:

_____

Which force, Normal or Gravity, has more pull/push when the Buggy is traveling on a slope going down? _____
And the winner is….._____Explain your idea:

_____

My Questions are:
If the **Mass** (weight) of the Buggy was 907 KG (2,000 LBs), do you think this greater **Mass** would bring much greater Gravity downward pull? _____
Explain your thinking _____

_____

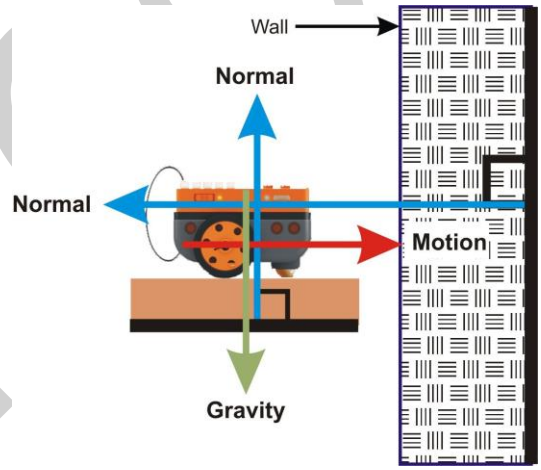
What's your angle?: Perpendicular is when two lines (or walls) meet at a right angle such as we see in **Group A** below. **Group B** are examples of lines that are on non-square angles and <u>not</u> Perpendicular. Perpendicular is important to understand in order to understand **Normal Force**.

Group A **Group B**

Research It!

Normal Force:

Normal force is always **perpendicular** (⊥) from the surface on which an object, such as Buggy, sits. In the left diagram, Normal force is perpendicular to the table. (Look at how the blue arrow and black line are perpendicular). When the table is level the Normal and gravitational force are equal (balanced). It is stopping the Buggy from traveling through the table/desk top.



We said **Normal** force is always **perpendicular** (⊥) from the surface on which it sits. What happens when the Buggy is in **Motion** and hits a wall?

_____

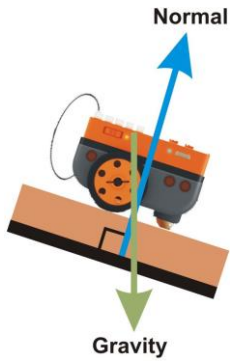
_____

Remember this video….

File: **Buggy Impact with Wall.MOV**

So…. Do you see the blue arrow perpendicular to the bold black line on the wall's surface? _____

So Normal force and Gravity are at it again!



As the table/desk tilts more and more, the Buggy moves down the ramp. Does the effect of the normal force increase or decrease? _____

Why? Explain

_____

_____

Try It!

Place your hand under your textbook and hold it up. Think: Can you feel the normal force pushing up? What if you tilted your hand so that the book is on an incline? Think: What will happen to the book?

Do It! What happened? _____

So…..

Normal force is **perpendicular** ⊥) from the surface on which the Buggy is touching. At the same time the Normal force is tilting away from the force of Gravity. As you increase the tilt of the table/desk (or in your experiment, the book), the Normal force becomes weaker. When you tilt the table/desk even more, the Normal force has even less effect and the Buggy will be pulled by the stronger Gravity force down the tilted table/desk (or textbook).

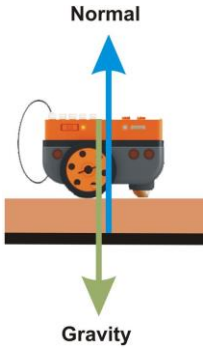
Reflect On It!

Illustrate the Buggy and “brick” wall experiment.

Label the Buggy and “brick” wall with the following:

- ➔Normal Force arrows (remember perpendicular (⊥) to a surface)
- ➔Gravity arrows (remember perpendicular (⊥) to asurface)

Buggy moving but has not hit “brick” wall yet
Explain your labels based on your research:
Buggy hitting “brick” wall with brick pieces falling
Explain your labels based on your research:



What is a **Balanced** force?

When all forces acting on an object, such as the Buggy, are equal it is called **Equilibrium**. When there is equilibrium, the object such as the Buggy sitting on a flat table/desk *does not move*. This is a **Balanced** force.

What is an **Unbalanced** force?

Unbalanced force is when a force causes a change in the motion (or 'at rest state) of an object. A result of an unbalanced force on an object, such as the Buggy, is it will cause it to move. This is **Acceleration** and **Motion**.

Left diagram: The purple arrow on the left (of the grey hand) is a **moving force** *approaching* the 'at rest' Buggy.

Right diagram: The Force is now a pushing force on the Buggy causing **MOTION.**

In what direction will the Buggy go if there is an Unbalanced force? _____

Which of Newton's law/s does this demonstrate?: _____

Explain your thinking:

_____

_____

Apply It!

Newton's First Law of Motion (Law of Inertia):

Objects at rest stay at rest, objects in motion stay in motion UNLESS an unbalanced force acts upon it.

Newton's Second Law of Motion:

Acceleration happens when a force acts upon a mass. The greater the mass, the more amount of force is needed. (Acceleration is the change in speed)

Video View!

Video Clip 1 Buggy going into low brick wall File: **Buggy impact with Bricks.MOV**		Video Clip 2 Buggy going into un-moveable wall File: **Buggy impact with wall.MOV**

Create an illustration from the two videos you just viewed.
Label A - G in your illustration providing details to support your claim:

A) Evidence that something is at **rest**
B) Evidence that something is in **motion**
C) Evidence of **balanced force(s)**
D) Evidence of **unbalanced force(s)**
E) Evidence that **Newton's First Law** applies
F) Evidence that **Newton's Second Law** applies
G) Energy of Transfer of Energy

Chime Time! Provide evidence of one of the science concepts in your illustration.

Student Name_____ Date _____

Sessions 13 & 14:
Itty Bitty Sloth Has Come to Town Quest!

Look at the model of the Itty Bitty Sloth.
Find the pieces to make your Sloth.

OBSERVE IT!
Watch the video of the sloth in action.
File: **IBB Sloth walking rope.MOV**

Look at the diagram of pieces.
Circle the pieces you chose.

Now watch this video

File: **IBB Sloth walking rope.MOV**

Think: What do you notice?

Our Noticings:

1. _____
2. _____
3. _____
4. _____
5. _____

Sketch It!

Label the function of each piece that you will use

Analyze It!

How is your sketch similar to the photo and video on page 63?

_____

Think: Do you need to make some changes?_____Make them in your sketch!

How is it similar to the Buggy? _____

How is it different than the Buggy? _____

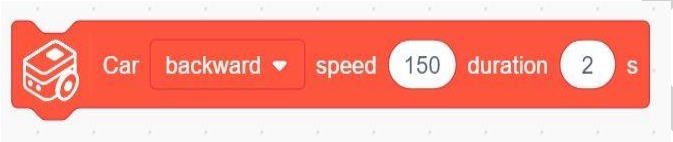
Assemble It!

Assemble your sloth now! Follow the steps with the link below.
https://umodel.microduio.cn/Assembly3D/index.html?name=sloth&lang=Eng
Or use thisFile: **Microduino Itty Buggy Sloth Build instructions.pdf**

Code It & Test It!

Code the sloth to go in a loop that does the following:

- ➔ Wait for 2-seconds
- ➔Make the LED lights change to green
- ➔Go forward for 7-seconds. Use this mDesigner block code set to 'forward' and duration set to '7':



- ➔Wait for 2 seconds
- ➔Make the LED lights change to red
- ➔Go backward for 7-seconds

SKETCH how your sloth moved from your code.
Put in the blocks in your script that you created to operate your sloth.

SLOTH MOTION	CODED SCRIPT OF SLOTH

Just HANGING Around Quest! What is the sloth UP to? Watch it!

With the help of your teammate -

Put a rope running horizontal between two points. Make sure the rope is tight. Put your sloth at the start line on the hanging rope. (The distance between beginning & end is about two - three feet.)

Test It!

Run your code and record how your sloth moved on the rope.

How does the motion of your Sloth relate to a simple machine in lesson 9?
Our observations and research: _____

_____

_____

Analyze It!:

Does one part of the Sloth's action move differently than the other?
HINT: Look at the gears moving the levers. Then…. look at the levers moving the other levers.

Energy Look Out!

There is rotational energy. And…
There is linear energy. What word do you see in "**line**ar"? _____

Question It!

What do we call the energy where the gears move the levers? _____
What do we call the energy where the levers move other levers? _____

Based on what you have discovered about **transfer of energy**, where would you say this transfer occurs? _____

Explain: _____

Reflect!

Re-analyze the lever motions in the video of the sloth.

File: **Sloth gears & levers.MOV**

Observe how one lever acts upon another.
How many levers do you see moving one of the sloth's arms? _____
Based on the observations of the video, do levers always move in the same direction? _____

Provide evidence _____

_____

Remember It! What makes this a system? (you can refer to page 13 for reference)
Explain It: _____

_____

Draw a full rotation (turn) of the lever action below.

At what point(s) did you observe energy transfer? _____

_____

What is your evidence for your observation above?

_____

_____

What else do you know about energy transfer based on your previous understanding of the system of the Itty Bitty Sloth/Buggy? _____
_____(you can refer to page 13 for reference)

Connect It!
Review your observation of the gear connecting to the lever, and then the lever connecting to other levers….

Recalling Newton's Second Law ….
When objects (gear with the lever) 'collide', energy can be transferred from one object to another

The system of Sloth we observed shows evidence of a transfer of energy.

Statement 1: Agree or Disagree _____
Supportive Evidence:

Sketch & label the places where Sloth's energy transfer occurred (gears & levers)

SLOTH Race to the Finish Quest!

Pseudocode It!

Pseudocode your team's sloth to...

- ➔Climb across a one meter length rope to get to the other side
- ➔Reverse itself and come back to the starting point
- ➔Light up during both parts of its journey
- ➔Try to be the first to get back to the starting point!
- ➔How will you adjust the time the sloth runs in your code to make this happen?

Our Pseudocode:

Before	After

Code and Test it!
Test out your code.
Are you ready to enter the “SLOTH QUEST” competition vs. the other team?
Two teams will compete on one testing site. One team at a time!

Problem Solve It!
What modifications would you like to make to your code?

_____

Why?

_____

Re-test It!
Now’s the time to make any other last minute modifications!

The modifications we made were

_____

Test it Out ONE MORE TIME!
Time It! _____

Team 1 “SLOTH QUEST” competition begins!
One sloth at a time, please!
Ready, set go - have a partner start the stopwatch.

Observe it!
How did your sloth move?
Our time was _____

Team 2 now repeats the above procedure.
How did the other team’s sloth move?
Their time was _____
If you had more time, what modification would you make?

_____

How would this modification optimize your sloth design code?

_____

Read the two statements below:

Statement 1: *Simple machines can change the direction of forces*

Statement 2: *Simple machines multiply forces or multiply distances*

Based on the photo of the sloth to the right, the video link below, and your analysis of your sloth in motion, make a claim for each statement above and provide evidence to your claim about simple machines.

Video of sloth in motion:

File: **Sloth gears & levers.MOV**

Watch the motions! Map out the different forces that you spy force. What do you spy in the energy chain…follow it.

Claim #1: *Simple machines can change the direction of forces*

Evidence for Statement 1: _____

_____

Claim #2: *Simple machines multiply forces or multiply distances*

Evidence for Statement 2: _____

_____

_____

Chime Time! Based on the sloth gear and lever movie choose one claim from above and provide evidence.

Research Revisit: Newton's 3 Laws of Motion

1. Objects at rest stay at rest, objects in motion stay in motion UNLESS an unbalanced force acts upon it. *Can you create an unbalanced force to the sloth to make this law true. What would you do?*
2. Acceleration happens when a force acts upon a mass. The greater the mass, the more amount of force is needed. (Acceleration is the change in speed)
3. For every action there is an equal and opposite reaction.

Pick ONE of Newton's laws that applies to your sloth experiments.
Law # _____

Evidence that Newton's Law EXISTS in Itty Bitty Sloth!

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Illustration of Law in Itty Bitty Sloth (Include **labels** to support your thinking):

Gallery Walk! Display your labeled illustration for your classmates to see. Use post-its to share your thinking, ask questions, make comments for your peers to process.