

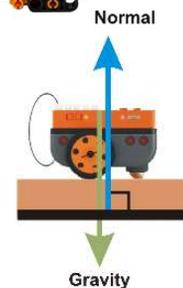
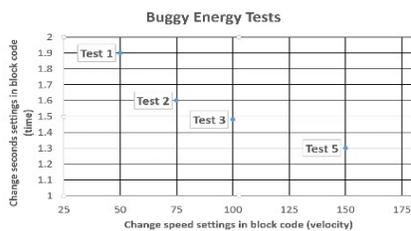
STEM/Makerspace NGSS Curriculum

Introducing

 MICRODUINO

Itty Bitty Series

“Buggy and Sloth”



Student Investigations Grade Band: 3rd - 6th

Students will: Learn how to apply block coding to the mechanical world as they construct ideas about forces and interactions along with energy and matter. Deconstruct and analyze components to see inside the world of electrical engineering.

Co-Developed by: Donna Migdol, Oceanside Union Free Schools
Bridgeman Carney, Microduino Inc.

Written by:

Donna Migdol

Oceanside Union Free School District, Oceanside New York

Ms. MIGDOL is a STEM teacher and professional developer for the six Oceanside (New York) elementary schools. Ms. Migdol previously taught grades 3-6 and was the mathematics and science lead teacher for the school district. Ms. Migdol has presented her classroom engineering design and math lessons to the Peer Review Panel in Albany, as well as to the National Science Foundation in Washington D.C. As a third grade teacher, WNET and Teacher Net filmed her classroom as engineering design coupled with inquiry-based math and science instruction was highlighted. Donna Migdol co-developed and facilitated the Math, Science, and Technology Summer Institute at Hofstra University and was part of a district team involved in a five year MSTe NSF funded grant led by facilitators at Hofstra University, Stony Brook University and Brookhaven Labs. She has served as an elementary mathematics and STEM/Makerspace consultant for school districts across Long Island and in NYC. Ms. Migdol has published several articles and her work as a teacher has been cited in Alfie Kohn's book, "The Schools Our Children Deserve". Ms. Migdol's work with students was also cited in chapter one of "Exemplary Science in Grades 5-8: Standards-Based Success Stories", edited by Robert E Yager. She partnered with Hofstra University's Center for Technological Literacy as a curriculum writer and professional developer for two grant - funded projects geared to support STEM literacy grades 6-8. Donna Migdol was the keynote presenter for Hofstra's HNET Conference where her presentation centered on "What a classroom could be..." In 2012, Ms. Migdol's fifth-grade class involved in roller coaster physics was filmed by WNET and The Teaching Channel. Donna Migdol also served as a judge for the NAE Engineering for You Video Contest. She also served as a committee member for the National Academy of Engineering/National Research Council Committee on Integrated STEM Education. The report, STEM Integration in K-12 Education -Status, Prospects, and an Agenda for Research was published in 2014. In 2015, Ms. Migdol co-chaired the National Academies convocation "Enhancing Teachers Voices in Policy Making for K-12 Engineering Education. The report, "Increasing the Roles and Significance of Teachers in Policymaking for K-12 Engineering Education" was published in 2017. Ms. Migdol co-presented a STEM workshop and served as a panelist at the STEM and The Next Generation Science Standards conference at the NY Hall of Science. She co-developed, integrated and facilitated a gradual release professional development model that implemented a comprehensive 3rd-6th grade STEM and a 1st -4th grade Makerspace program in the Oceanside schools. In 2016, Ms. Migdol was asked to co-present the Oceanside STEM district-wide implementation design to the Nassau County Assistant Superintendent's Organization. Shortly thereafter, Oceanside Schools housed two STEM Consortiums where over twenty five school district leadership teams from NYC and Long Island came to see Oceanside's integrated elementary STEM and Makerspace models. Ms. Migdol is also an adjunct professor at Hofstra University, where she teaches STEM graduate courses. She continues to search out ways to integrate student-centered learning strategies into a STEM experience for both elementary and college students who will eventually be asked to use their passion for science, math, and engineering to uncover solutions to the great problems we have left them to solve.

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Student Name _____

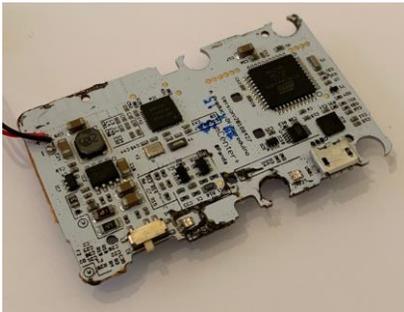
Date _____

Session 2

DECONSTRUCTION QUEST AND BEYOND

Top Chassis (assembled)

What do you see? What do you think the functions are of the components?



Circuit Board (inside)



Battery Inside (inside)

Analyze It!

Let's look at what is inside the top of Itty Bitty Buggy's Chassis.

Think: How do you think the circuit board operates?

What do the components do?

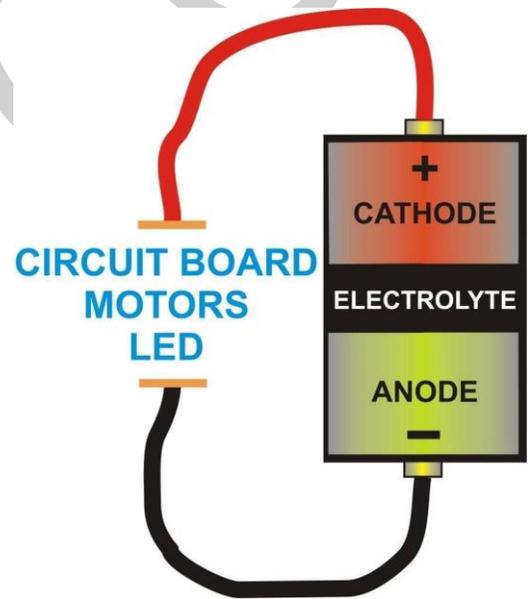
Think: How about the battery?

How does the battery provide power to Itty Bitty Buggy?

Research It!: The Battery

A battery is a storage unit which generates electrical power. It creates electricity by the reaction of chemicals inside the battery itself. Engineers have created many different designs battery using different materials and construction.

- It was discovered that certain chemicals create a build-up of electrons. This becomes the **anode** of the battery.
- These extra electrons want to go someplace but they cannot do so on their own. On a battery anode end is designed at the '-' symbol on the battery.
- The other end of battery has a chosen chemical that has few electrons and is called the **cathode**. This is marked with a '+' symbol.
- In the middle of the battery is a layer called the **electrolyte** which keeps the extra electrons of the **anode** chemical from going straight from the anode to the **cathode** within the battery.
- A direct connection from the anode to the diode would release a lot of immediate energy.
- Eventually the chemicals in the battery become worn out and they battery has no power.
- Rechargeable batteries, however, have special chemicals (and cost more) and can restore with an electrical charge.
- The design of the circuits on our circuit board ensure we only use the power from the battery we need. When we connect a battery to circuit, such as in the Itty Bitty Buggy, the battery is providing electricity that powers the circuit board, motors, LED and buzzer.



Be good to the earth!

** The chemicals in a battery are harmful to the touch and to the soil. Dispose of them properly!

What I learned from my Battery research:

→

→

→

→

DO NOT COPY

Research It! Read with a partner. Highlight important information.

Parts of a PCB (Printed Circuit Board) and functions

The operation of the Buggy is controlled by the main circuit board in the (orange) top half of the Buggy. This main circuit board is a computer and an essential part of the Buggy!

Research the PCB in more detail below and all that it does:

A: Central Processing Unit (CPU).

This is an Integrated circuit chip which is the **'brain'** that controls all the actions of the components of the Buggy

B: Circuit Board. The circuit board has 100's of 'flat wires' built into it electronically to connect all the components

C: ICs. In the CPU there are additional ICs (Integrated Circuit) chips that help the CPU control other Buggy parts

D: The Recharge/Programming socket. The connector into which the recharge cable is plugged in.

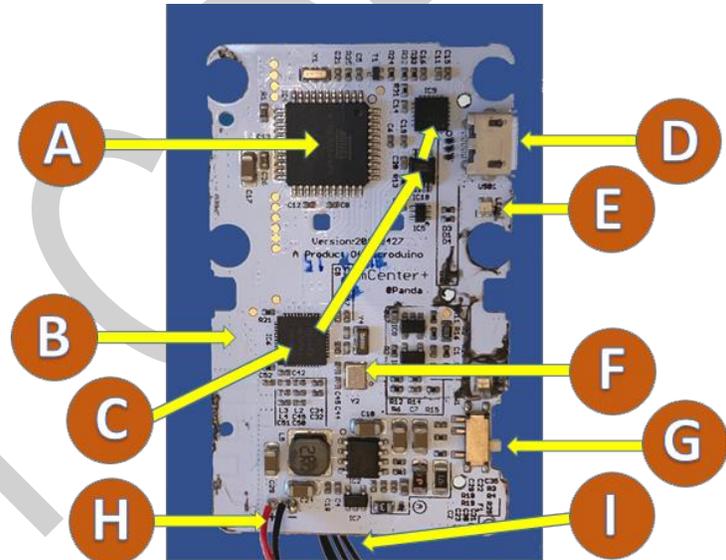
E: Bluetooth indicator LED (Light Emitting Diode). Gives us visible signals to see if we are connected to a Bluetooth (wireless) device such as a smartphone or tablet.

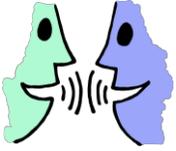
F: Clock crystal. The CPU and all other ICs and components on the circuit board must have a very precise clock that runs in millionths of a second.

G: On/Off Switch. This is the switch that turns on or off the power from the Buggy's battery.

H: Power wires: Brings the power from the Buggy's battery to the circuit board. When the power switch is turned on it, energizes circuit board components.

I: Interconnect cable: Connects the Buggy's upper circuit board, which is the top orange plastic case on top, to the Buggy's lower circuit board, which is the lower grey plastic case, where the Buggy's 2 motors and LEDs are located.





It's CHIME Time!

Take a few moments with your partner to look through your reflections thus far, and decide on what you would like to CHIME!

What I learned from my PCB (Printed Circuit Board) research:

→

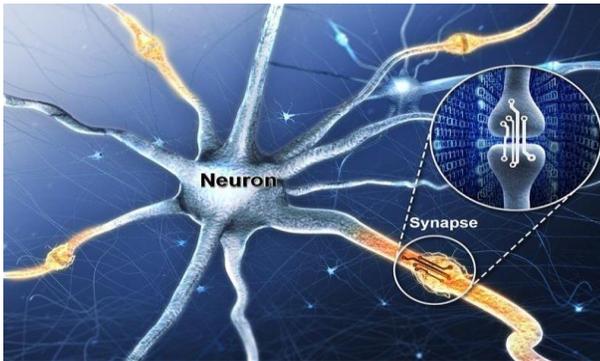
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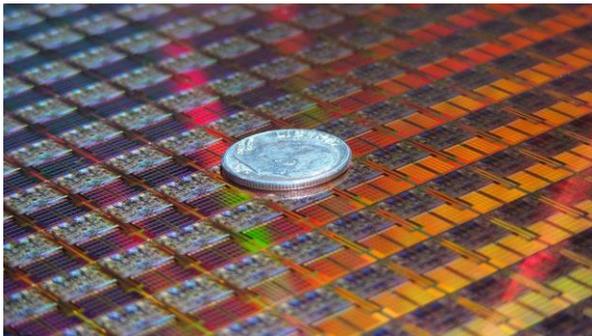
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BRAIN SYNAPSES AND CIRCUIT BOARD TRANSISTORS: What's the Connection?



The human brain and body have millions of connections called **synapses**. Synapses transfer electrical charges (**information**) back and forth along the body's nervous system. Most everything a human body relies on this system. The transfer of signals jumps from synapse nerve to synapse nerve. The space between each synapse is very small with a spacing of only 30-50 nanometers per synapse (there are 25,400,00 nanometers in an inch).

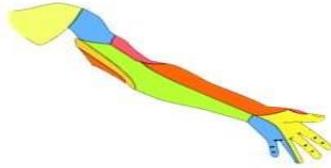


A computer's Central Processing Unit (CPU) chip, is the "**brain**" of the computer. It has large numbers of tiny transistors integrated into a small chip. Transistors hold a small electrical charge (**information**) that they hold or transfer to other transistors. The CPU may have many billions of transistors in an area the size of a human fingernail. That is a spacing of about 14 nanometers per transistor.

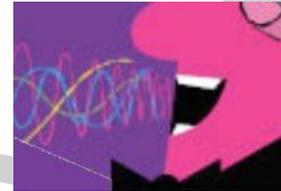
Designing a CPU, a circuit board, wiring layout, motors and more are some types of work that would be done by an **electrical engineer!**
How are parts of the Buggy like the parts of your body?



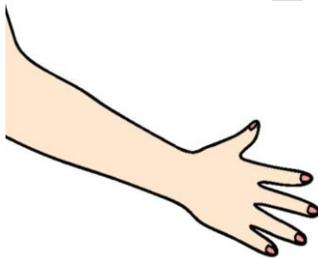
CPU is like brain because it controls the Buggy



The **motors** are like an arm or leg because they create movement



The **buzzer** is like a voice because it make noise



The Buggy's **plastic shell** is like skin to protect the Buggy



The **circuit board** is like a nervous system because it sends and receives signals

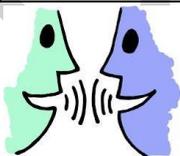
What I learned from my Human Body and Buggy system research:

-
-
-
-

Statement: Itty Bitty Buggy system is similar in many aspects to the Human Body System

Agree or Disagree with this statement? _____

Provide Evidence to your claim:



It's Chime Time!

Analyze It! (Video 2)

Watch again the video of Itty Bitty Buggy in Motion! (forward, back, left turn, right turn, spin, sound, light LED)

File: [Brief Buggy demo.MOV](#)

Think: How does it move?

What components are causing this function? How? What is sending the signal?

Components

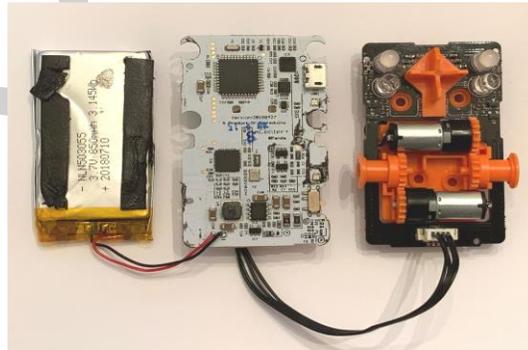
Buggy System Function

Components	Buggy System Function

ALL SYSTEMS GO!

A system is an organized group of related objects or components that form a whole to perform a function(s)

Is **THIS**
a system?



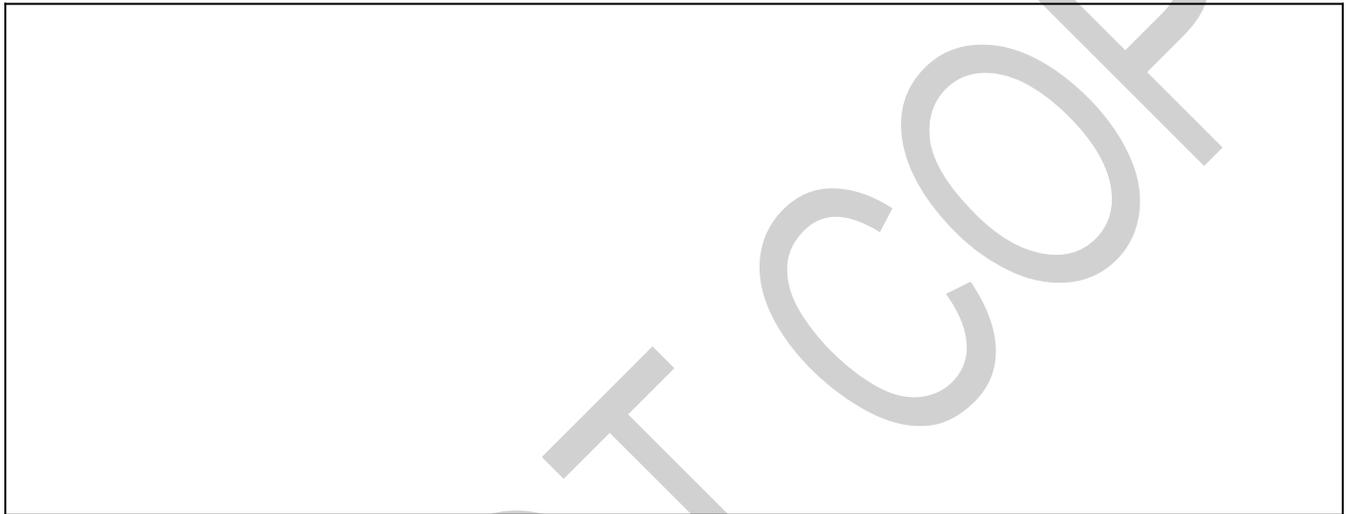
Based on the videos, the photo on the previous page, and other research from Itty Bitty Buggy Sessions 1 and 2 answer the following question:

Is Itty Bitty Buggy a system?

Claim: _____

Evidence to your claim:

Diagram and label your evidence!



It's Chime Time! Is this Itty Bitty Buggy a system? What makes a system a system?

Student Name _____

Date _____

Sessions 3 and 4

What a Clue!

Get familiar *with using the mDesigner Scratch code editor to CODE and so much more!*

CODE CLUES QUEST!

Open your mDesigner Scratch Editor application. If you are using a Chromebook it should be in the bookmarks of the browser. If you are using a PC or a MAC it should be on your Desktop on your screen.

1. Open the file below to review the basics to using mDesigner Editor keeping in mind the questions above

File: [mDesigner Basics - Chromebook.PDF](#)

2. After viewing and taking notes from the **SCRATCH** tutorial, as well as experimenting on your device with mDesigner, jot down what you learned.

Our Notes:

→
→
→
→

Code Designer Check Point!

What does the process of coding do to improve your thinking skills?

While you are in mDesigner, what part of the screen is the 'script area'?

Where is the toolbar? _____

What things can you do from the toolbar?

What are code blocks?

A script is _____

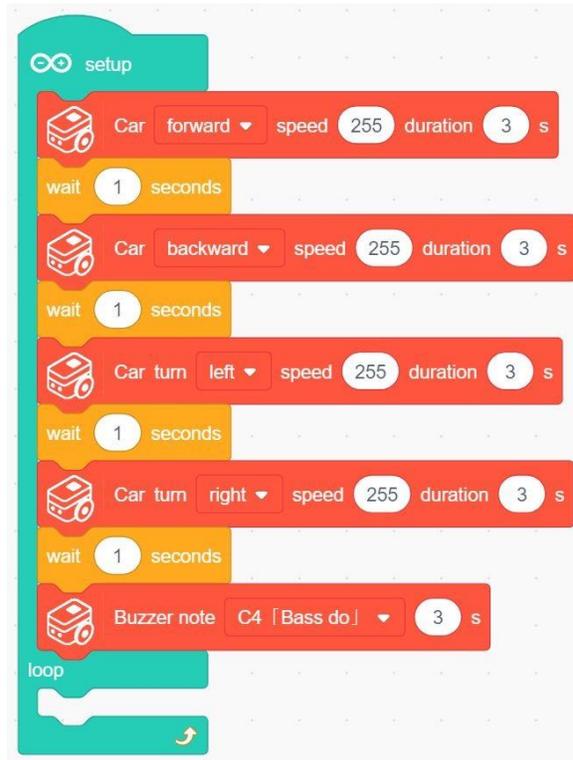
Every script needs to start with what special code block? _____

Code blocks are stored on the left side of the mDesigner page.

How do you put code blocks into the script area? _____

Analyze It!

Look at the code for Itty Bitty Buggy below.



The code is a Scratch script for a car. It starts with a 'setup' block containing the following sequence of blocks: a 'Car forward' block (speed 255, duration 3 s), a 'wait 1 seconds' block, a 'Car backward' block (speed 255, duration 3 s), another 'wait 1 seconds' block, a 'Car turn left' block (speed 255, duration 3 s), a 'wait 1 seconds' block, a 'Car turn right' block (speed 255, duration 3 s), another 'wait 1 seconds' block, and finally a 'Buzzer note C4 [Bass do]' block (duration 3 s). The script ends with a 'loop' block.

Think: If it were a story that you were reading from top to bottom, what would happen?

In the chart below, draw the block next to your story sequence to provide evidence.

CODE STORY

	Written story in steps	Block Code	Block Color
1			
2			
3			
4			
5			
6			

RUN IT!

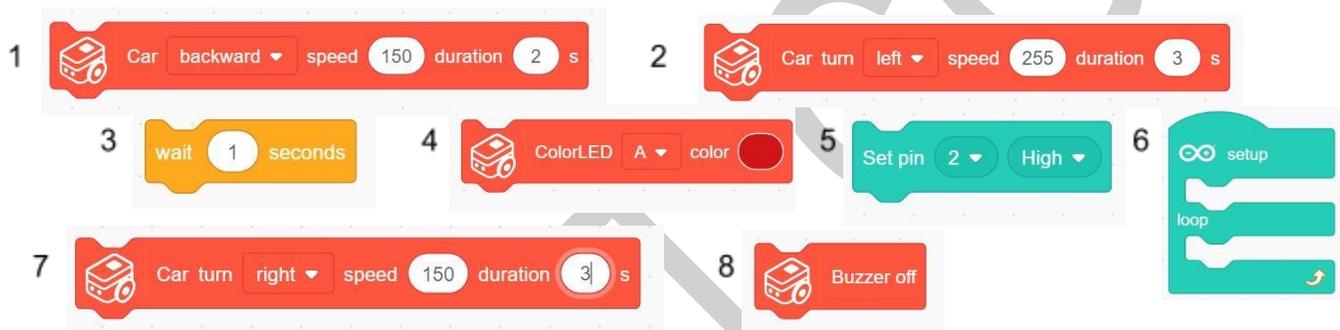
Copy the code set above into mDesigner! What happened?
Compare your “code story” to the Itty Bitty Buggy trial run.

Differences: _____

Similarities: _____

LET'S CONTINUE TO Pseudocode!

Look at the coding blocks below.



Use the blocks above to make your Buggy do the following:

We want to make the Buggy do the following steps:

- move straight for 5 seconds at speed 125
- wait 2 seconds,
- turn right at speed 200 for 3 seconds,
- wait 3 seconds, light up LED red,
- wait 5 seconds,
- turn LED off (black)

So THINK:

- Which blocks would you use?
- What would the order be?
- Why did you put the script in that order?
- How is information getting from your device to the Buggy?

Record It!

FILL IN THE CHART BELOW.

For the 'Block' column below place number of the Block code you choose (shown as Blocks 1-8 on the previous page) and enter the number.

Block number	Function

Code It!

Use the mDesigner SCRATCH editor!

Test It!

Run the code.

What happened? _____ (failed forward OR met with success)

How can you modify your pseudocode to get the Buggy to run correctly?

Pseudocode modification: _____

What happened during your second trial run? _____

Write your pseudo code modifications to get the Buggy to run correctly.

Pseudocode modifications: _____

Save It!

On your device NAME it: Session 3 and 4 with your team's first names
