BristleBots

WHAT: Bristlebots are made of a vibration motor, battery, toothbrush, and foam tape. The robot is brought to life by completing a simple circuit between the battery and motor.

YOUR CHALLENGE:
Use the materials provided to design your own bristlebot.

- ➔ Can you make a switch?
- ➔ Can you redesign your bot to move faster, slower, straight, or in circles?
- ➔ Design a bot with animal or creature characteristics?

BristleBot Next Generation Science Standards (NGSS) & Connections

GRADE	NGSS	CONNECTIONS
K-2	**K-2 Engineering Design** **K-2 ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **K-2 ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **2 Matter and Its Interactions** **PS1-1.** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	**Practice Standards[1]** ● Asking Questions and Defining Problems ● Developing and Using Models ● Analyzing and Interpreting Data **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically
3-5	**4-PS3 Energy** **4-PS3-1.** Use evidence to construct an explanation relating the speed of an object to the energy of that object. **4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	**Practice Standards[1]** ● Asking Questions and Defining Problems ● Planning and Carrying Out Investigations ● Constructing Explanations and Designing Solutions **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically
6-8	**MS-ETS1 Engineering Design** **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4**. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	**Practice Standards[1]** ● Asking Questions and Defining Problems ● Developing and Using Models ● Analyzing and Interpreting Data ● Engaging in Argument from Evidence **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically

Materials

● Coin cell battery ● Vibration motor ● Cheap toothbrush	● Pipe cleaners & art supplies ● Double sided foam tape

References:

[1]Next Generation Science Standards, DCI Arrangements, http://bit.ly/DCI_NGSS

[2] Cheuk, T. (2013). *Relationships and convergences among the mathematics, science, and ELA practices.* Refined version of diagram created by the Understanding Language Initiative for ELP Standards. Palo Alto, CA: Stanford University http://bit.ly/DCI_NGSS

Draw Bots

WHAT: Draw Bots are drawing robots made out of a DC hobby motor, battery pack and art supplies. The robot is brought to life by completing a simple circuit between the battery and the motor.

YOUR CHALLENGE: Use the materials provided to make your own Draw Bot.

CAN YOUR BOT DRAW:

- ➔ Dotted lines?
- ➔ Straight lines?
- ➔ In circles?

Draw Bots Next Generation Science Standards (NGSS) & Connections

GRADE	NGSS	CONNECTIONS
K-2	**K-2 Engineering Design** **K-2 ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **K-2 ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **2 Matter and Its Interactions** **PS1-1.** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. **PS1-2.** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. **PS1-3.** Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassemble and made into a new object.	**Practice Standards** • Asking Questions and Defining Problems • Developing and Using Models • Constructing Explanations and Designing Solutions • Analyzing and Interpreting Data **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively
3-5	**3-5 Engineering Design** **3-5-ETS1-1.** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **3-5-ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **3-5-ETS1-3**. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. **3-PS2 Motion and Stability: Forces and Interactions** **3-PS2-1.** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **3-PS2-2**. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.	**Practice Standards** • Asking Questions and Defining Problems • Planning and Carrying Out Investigations • Developing and Using Models • Constructing Explanations and Designing Solutions **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively
6-8	**MS-PS2 Motion and Stability: Forces and Interactions** **MS-PS2.** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. **MS-PS2-5.** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting force on each other even though the objects are not in contact.	**Practice Standards** • Asking Questions and Defining Problems • Planning and Carrying Out Investigations • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively
High School	**HS-PS2 Motion and Stability: Forces and Interactions** **HS-PS2-5.** Plan and conduct an investigation to provide evidence that an electrical current can produce a magnetic field and that a changing magnetic field can produce an electric current. **HS-PS3 Energy** **HS-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	**Practice Standards** • Asking Questions and Defining Problems • Planning and Carrying Out Investigations • Developing and Using Models • Constructing Explanations and Designing Solutions **Relationships and Convergences[2]** **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively

Materials

- Hobby motor
- Battery pack for 2 AA batteries w/ snap connector
- 2 AA batteries
- Snap connector
- Double sided foam tape
- Duct tape
- 16 ounce plastic cup or other recycling

References:

[1]Next Generation Science Standards, DCI Arrangements, http://bit.ly/DCI_NGSS

[2] Cheuk, T. (2013). *Relationships and convergences among the mathematics, science, and ELA practices.* Refined version of diagram created by the Understanding Language Initiative for ELP Standards. Palo Alto, CA: Stanford University http://bit.ly/DCI_NGSS

littleBits Kinetic Robots

WHAT: littleBits are small electronic components that snap together with magnets to create a circuit. littleBits kits include components such as power, sensors (inputs), sound/lights/numbers (outputs) and a whole bunch more.

YOUR CHALLENGE: Using recyclable materials & littleBits build a robot that moves and makes sound.

CAN YOU DESIGN A BOT THAT:

- ➔ Has a real world application?
- ➔ Uses a sensor to initiate it's actions?
- ➔ Creatively integrates a switch (on/off) function?

littleBits Next Generation Science Standards (NGSS) & Connections

GRADE	NGSS	CONNECTIONS
K-2	**1-PS4 - Waves and their Applications in Technologies for Information Transfer** **1-PS4-1.** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. **1-PS4-4.** Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	**Practice Standards**[1] ● Planning and Carrying Out Investigations ● Constructing Explanations and Designing Solutions **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically
3-5	**4-PS3 Energy** **4-PS3-1.** Use evidence to construct an explanation relating the speed of an object to the energy of that object. **4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	**Practice Standards**[1] ● Asking Questions and Defining Problems ● Planning and Carrying Out Investigations ● Constructing Explanations and Designing Solutions **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically
6-8	**MS-PS3 Energy** **MS-PS3-2.** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. **MS-ETS1 Engineering Design** **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	**Practice Standards** ● Asking Questions and Defining Problems ● Planning and Carrying Out Investigations ● Constructing Explanations and Designing Solutions ● Engaging in Argument from Evidence **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively
High School	**HS-PS2 Motion and Stability: Forces and Interactions** **HS-PS2-5.** Plan and conduct an investigation to provide evidence that an electrical current can produce a magnetic field and that a changing magnetic field can produce an electric current. **HS-PS3 Energy** **HS-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	**Practice Standards** ● Asking Questions and Defining Problems ● Planning and Carrying Out Investigations ● Constructing Explanations and Designing Solutions ● Engaging in Argument from Evidence **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively

Materials

- littleBits (http://littlebits.cc/)
- Cardboard boxes/recyclables
- Craft tape
- Feathers/pipe cleaners/tissue paper

References:
[1]Next Generation Science Standards, DCI Arrangements, http://bit.ly/DCI_NGSS

[2] Cheuk, T. (2013). *Relationships and convergences among the mathematics, science, and ELA practices.* Refined version of diagram created by the Understanding Language Initiative for ELP Standards. Palo Alto, CA: Stanford University http://bit.ly/DCI_NGSS

Rube Goldberg Scratch Machine

WHAT: A Rube Goldberg machine is an invention/device that uses a series of chain reactions to accomplish a seemingly simple task. Think: objects rolling, lifting, pouring, bumping, turning, falling, etc.

YOUR CHALLENGE:
Create the most interesting and complex path between the motor (the kicker) and the distance sensor.

CONSIDER:

- ➔ How many moving pieces can you create?
- ➔ The aesthetic quality of your construction.
- ➔ What pieces can you add/subtract/modify?
- ➔ Customize the scratch program to do something different?
- ➔ How tall can you go?

Rube Goldberg Next Generation Science Standards (NGSS) & Connections

GRADE	NGSS	CONNECTIONS
K-2	**K-2 Engineering Design** **K-2 ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. **K-2 ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **K-PS2 Motion and Stability: Forces and Interactions** **K-PS2-1.** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.	**Practice Standards**[1] • Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out an Investigation • Analyzing and Interpreting Data **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically
3-5	**3-5 Engineering Design** **3-5-ETS1-1.** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **3-5-ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **3-5-ETS1-3**. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. **3-PS2 Motion and Stability: Forces and Interactions** **3-PS2-1.** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **3-PS2-2**. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. **4-PS3 Energy** **4-PS3-1.** Use evidence to construct an explanation relating the speed of an object to the energy of that object.	**Practice Standards** • Asking Questions and Defining Problems • Planning and Carrying Out Investigations • Constructing Explanations and Designing Solutions **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively
6-8	**MS-ETS1 Engineering Design** **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **MS-PS3 Energy** **MS-PS3-5.** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	**Practice Standards**[1] • Asking Questions and Defining Problems • Developing and Using Models • Analyzing and Interpreting Data • Engaging in Argument from Evidence **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically
High School	**HS-PS2 Motion and Stability: Forces and Interactions** **HS-PS2-5.** Plan and conduct an investigation to provide evidence that an electrical current can produce a magnetic field and that a changing magnetic field can produce an electric current. **HS-PS3 Energy** **HS-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. **HS-ETS1 Engineering Design** **HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller,more manageable problems that can be solved through engineering.	**Practice Standards**[1] • Asking Questions and Defining Problems • Using Mathematical and Computational Thinking • Developing and Using Models • Analyzing and Interpreting Data • Engaging in Argument from Evidence **Relationships and Convergences**[2] **MP3 and EP3.** Construct viable and valid arguments and critique reasoning of others **EP5.** Build upon the ideas of others and articulate their own clearly when working collaboratively **MP5.** Use appropriate tools strategically

MATERIALS

- Lego WeDo 2.0 kit (https://education.lego.com/en/lesi/elementary/wedo-2)
- Laptop for Scratch
- Assorted recyclables
- Craft and duct tape
- Balls

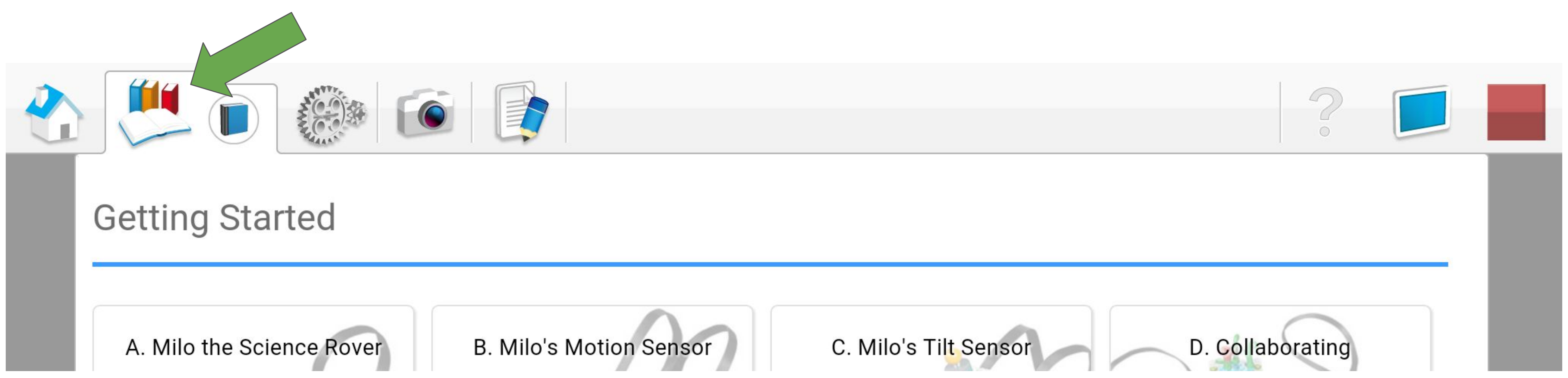
References:

[1] Next Generation Science Standards, DCI Arrangements, http://bit.ly/DCI_NGSS

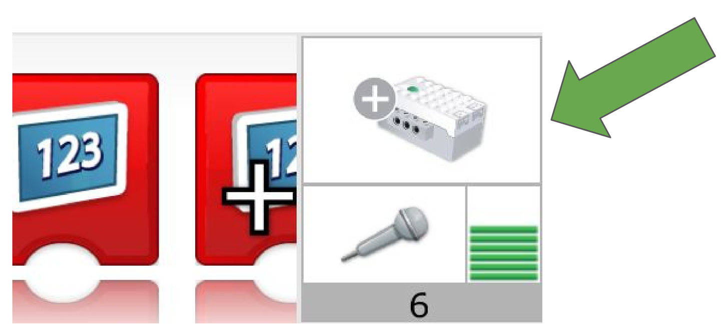
[2] Cheuk, T. (2013). *Relationships and convergences among the mathematics, science, and ELA practices.* Refined version of diagram created by the Understanding Language Initiative for ELP Standards. Palo Alto, CA: Stanford University http://bit.ly/DCI_NGSS

WeDo 2.0 Tips

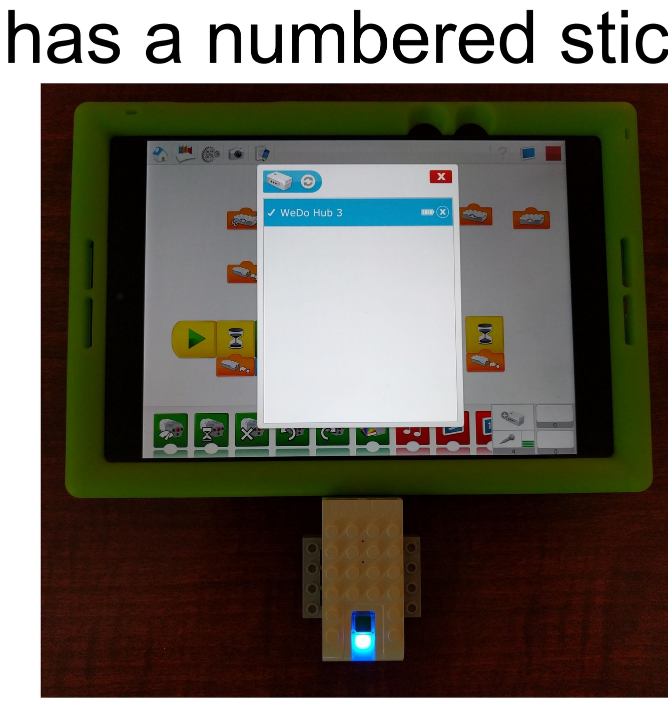
1. Tap this icon to start a new program 
2. Tap the books to hide the "Getting Started" guides



3. Tap the picture of the WeDo Hub in the bottom right hand corner to start the pairing process



4. Press the green button on top of the WeDo Hub then select the right number Hub on the tablet. (Each WeDo hub has a numbered sticker on the front)



5. When the blue light comes on the WeDo Hub you are ready to start programming!

You can change the sensor blocks to a few different modes by tapping on them

Distance sensor modes

The sensor blocks can be attached to a wait block to control the flow of the program.

Wait until distance is near

WeDo 2.0 Solution

The following program is a quick way to jump in and embed LEGO WeDo in your design. If this program does not quite meet your needs, take the plunge and start hacking!

The blocks above will make the program wait until an object is detected near the distance sensor, then it will turn on the motor for 5 seconds.

INDEPENDENT ACTIVITY

Selfie Corner

Take a minute to share what…

Surprised you!

Excited you!

Scared you!

Perplexed you!

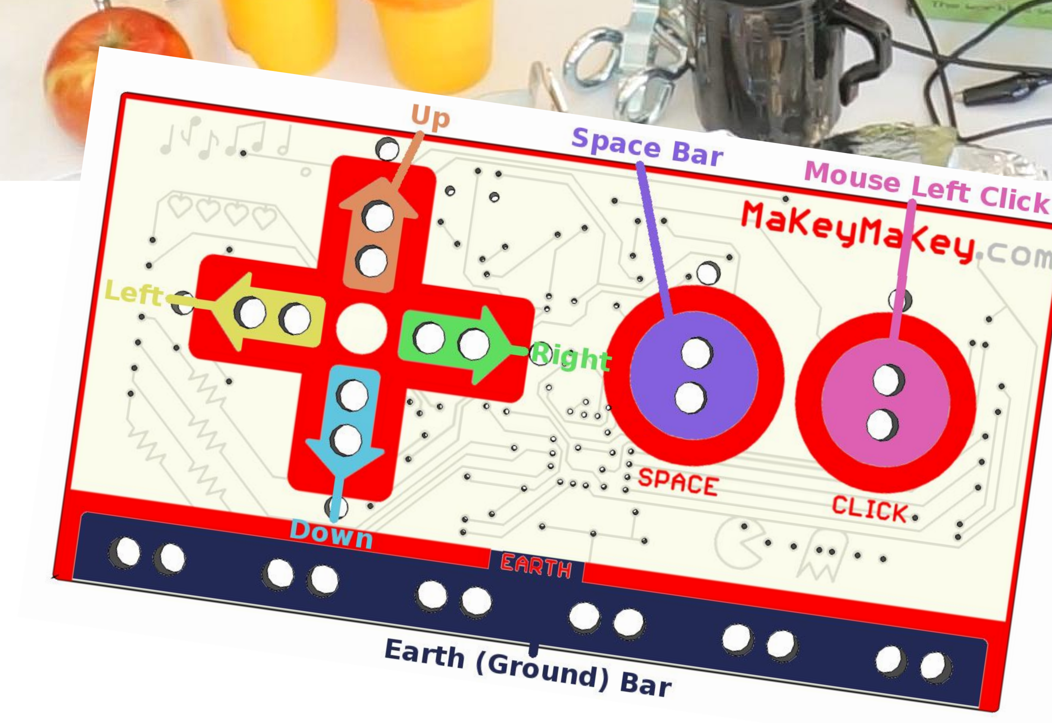
Inspired you!

Be sure to include **#SXSWedu**
(We are tweeting via @lesleysteam)

MaKey MaKey Mashup

WHAT: MaKey MaKey works by creating simple circuits connected to an input (space key, up arrow key). Control the computer by turning conductive objects like fruit, tin foil, and water into a touch pad, mouse or keyboard. With Scratch, you can program interactive stories, games, animations, and music — and share your creations with others.

YOUR CHALLENGE:
Use conductive materials (and your voice!) to create an original piece of music.



CAN YOU:

➔ Record your own sound?
➔ Use the repeat or forever blocks to create loops?
➔ Customize the background and create your own sprite?
➔ Design a keyboard that plays notes?

INDEPENDENT ACTIVITY

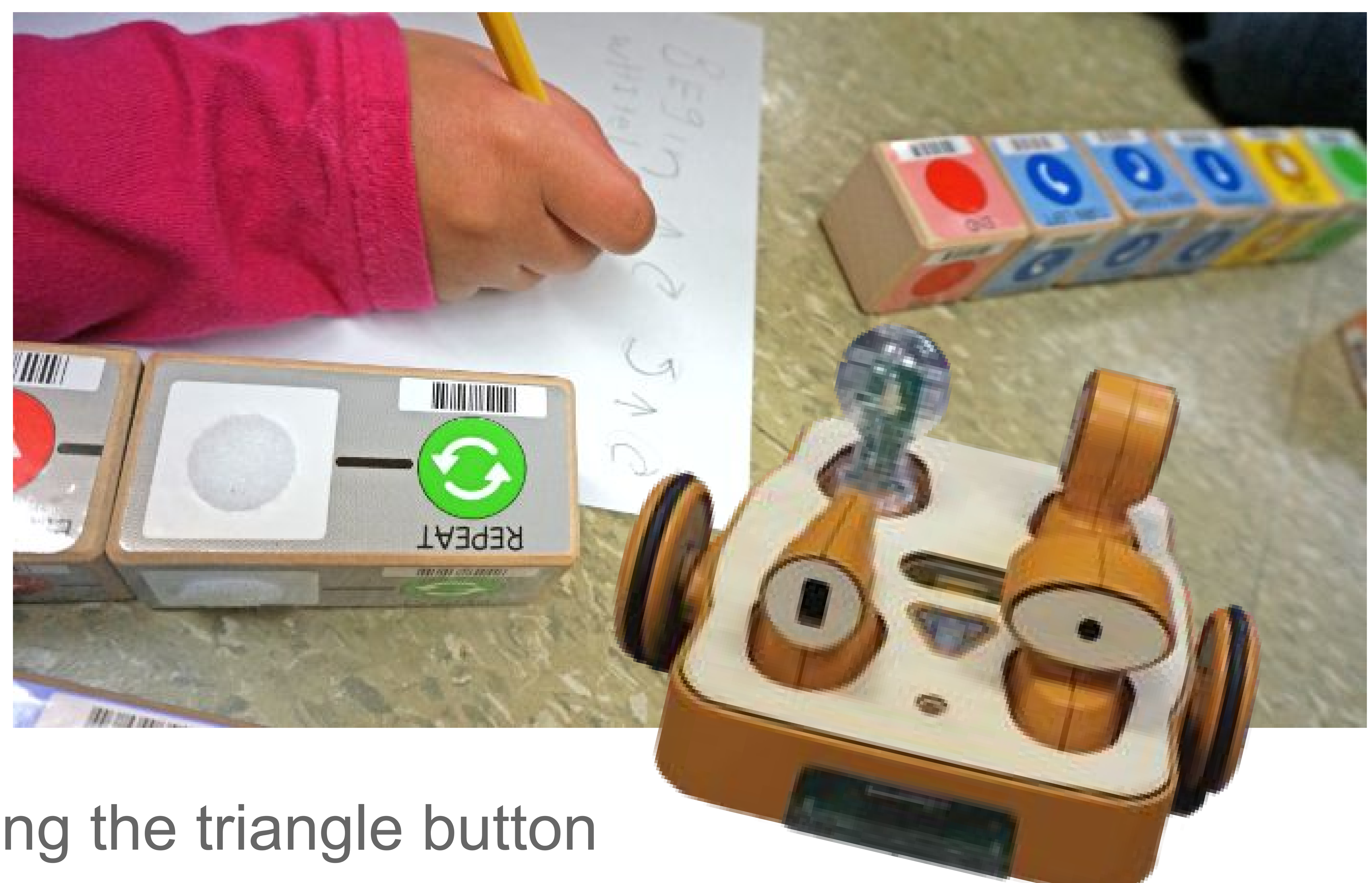
Kibo Robot

WHAT: The KIBO robot is programmed by sequencing wooden blocks to create a “program” - or set of instructions. The blocks are then scanned and with the push of a button, the KIBO is on the move. The KIBO includes repeat and conditional blocks, as well as sensors for light, sound, and distance.

YOUR CHALLENGE: Program the KIBO to dance.

CAN YOUR KIBO:

➔ Spin around 360 degrees?
➔ Repeat a move?
➔ Use a sensor to trigger an action?



HINTS:

- KIBO turns on by pressing the triangle button on top. KIBO turns off automatically after a few minutes.
- Make sure you always start with **green start block** and end with the **red end block**.
- If using repeat, make sure to create a “repeat sandwich”: with the actions you want to repeat between the repeat and end repeat blocks.
- Scanning: hold the KIBO about a foot from the blocks, start with the green block and scan each block separately. You will hear a beep when it scans properly.

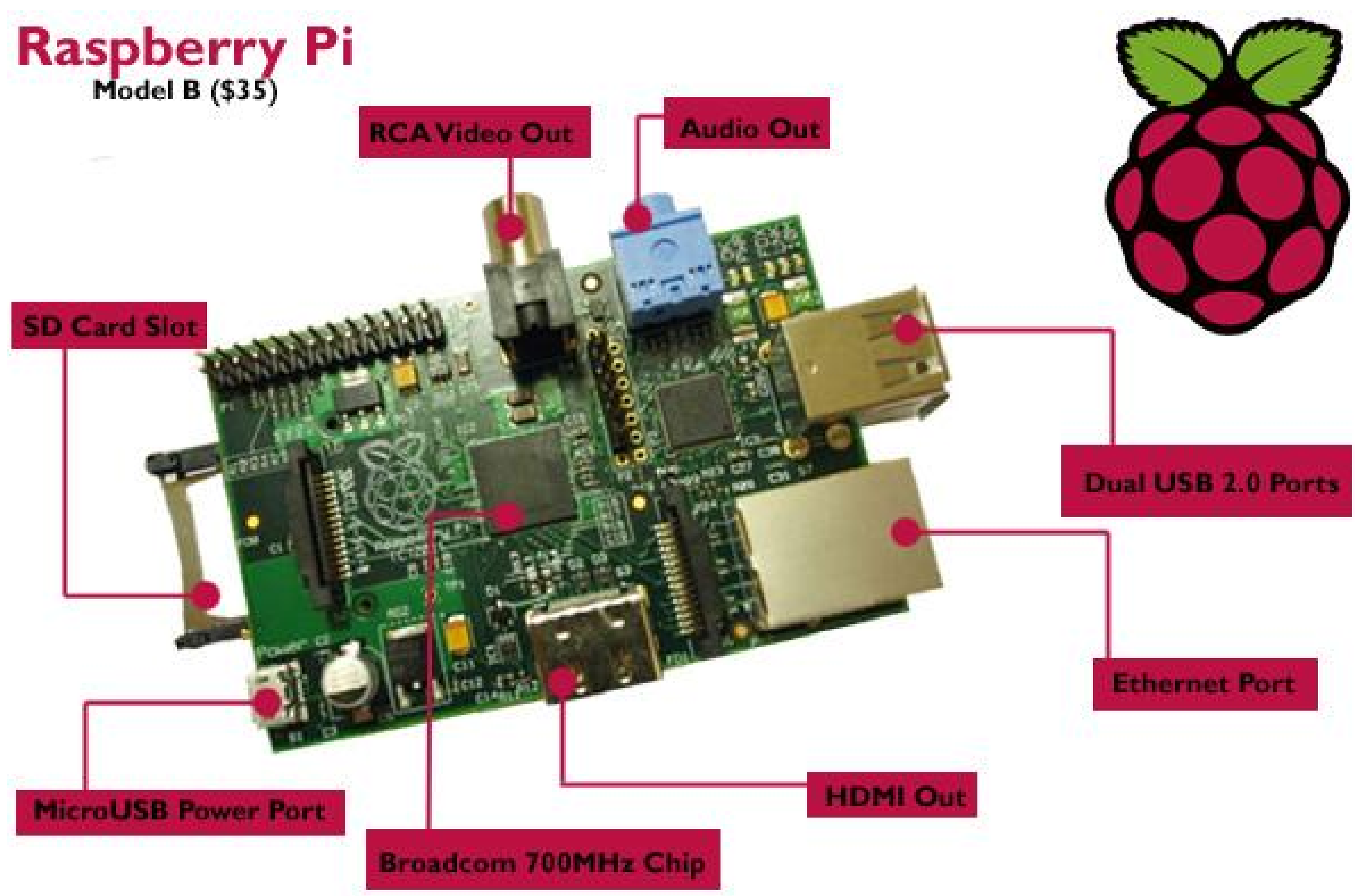
INDEPENDENT ACTIVITY

Raspberry Pi

WHAT: Looking for low cost solutions to address to digital inclusion and promote computer science? Look no further, the raspberry pi is here! Check out this credit card size computer that ranges in cost from $5 - 35, plus a little extra for your peripherals and your lunch box and you are on your way!

YOUR CHALLENGE: Explore how easy it is to navigate the Pi environment and try your hand at a little coding in Scratch v 1.4 or Python.

CAN YOU:
- ➔ Launch Scratch and make a short program?
- ➔ Launch Python and try your hand at this text based program?

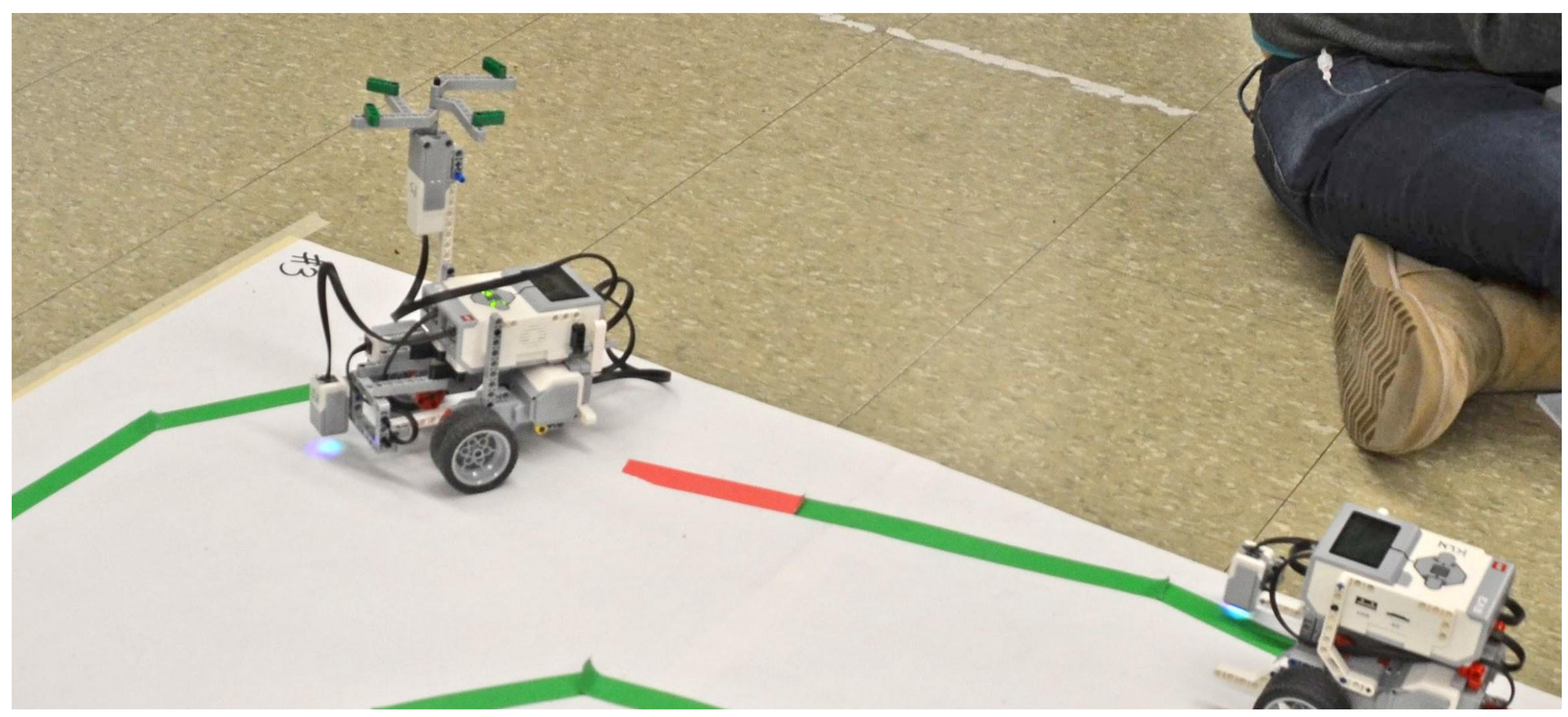


HINT:
- Go to the Start Menu (top left corner) and select Programming
- Use the stylus if your have that “all thumbs” feeling

EV3 Robot

WHAT: The Lego EV3 Mindstorm kit includes a programmable “brick”, sensors, motors, and a variety of Lego parts designed to create robots that walk, talk, think and do anything you can imagine.

YOUR CHALLENGE: Can you program the robot to pick up the “cargo”, transport it back to the drop zone, and then then return to it’s base?



CAN YOU:

- ➔ Make it do a victory dance and/or song?
- ➔ Extra, extra credit: Use sensors to complete the task more efficiently?

INDEPENDENT ACTIVITY

EV3 Robot

Code Hints:

Always start with one of these

Move

These numbers control the speed of the left and right motors. (-100 to 100)

Number of times the tires will rotate

Grab

The speed of the grab motor (-100 to 100)

Number of motor rotations (How far to squeeze)

Turn

Direction to turn.
-100 = Sharp left
100 = Sharp right

Speed of the motors. (-100 to 100)

Number of times the tires will rotate

Sound

Use this to select between Notes or Tones

Color Sensor Hint: