**Light Up My Life:**

**Introduction to External Devices with a Raspberry Pi**

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**District 65, Evanton, Illinois**

**Target Grade**: 6th Computer Science, STEM

**Time Required**: 60 minutes with optional extension

**Standards**:

*International Society for Technology in Education Standards:*

* 1 Empowered Learner - Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
  + 1d - Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.
* 3 Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
  + 3c - Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
* 4 Innovative Designer - Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
  + 4d - Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
* 5 Computational Thinker - Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
  + 5d - Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions

**Lesson Objectives:**

Students will:

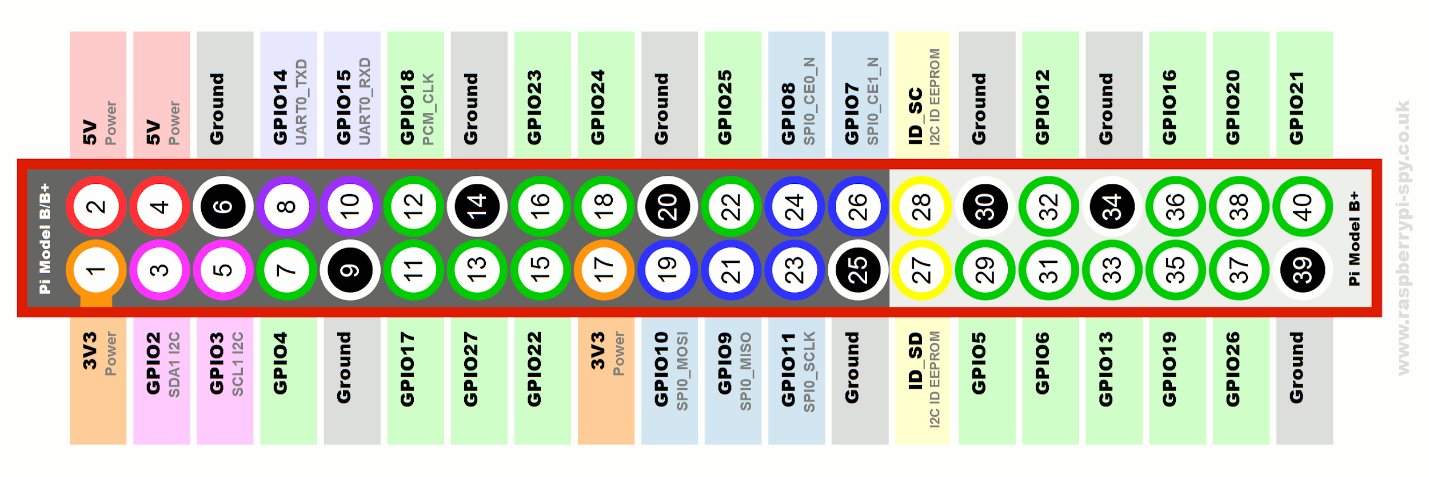
* Understand the makeup of a Raspberry Pi
* Experience coding through Scratch and Python languages
* Connect external devices using the GPIO pins
* Understand breadboards and basic circuitry

**Central Focus:**

Light up student engagement with this Raspberry Pi lesson! In this engaging technology lesson, students will learn to use Scratch and Python coding software to control a physical computing interface. Students will learn the importance of syntax in coding languages. Meeting ISTE standards, students will use the coding board to build knowledge in this lesson for future lessons.

Key terms: GPIO Pins, input, output, tech, code, compute

**Background Information**:

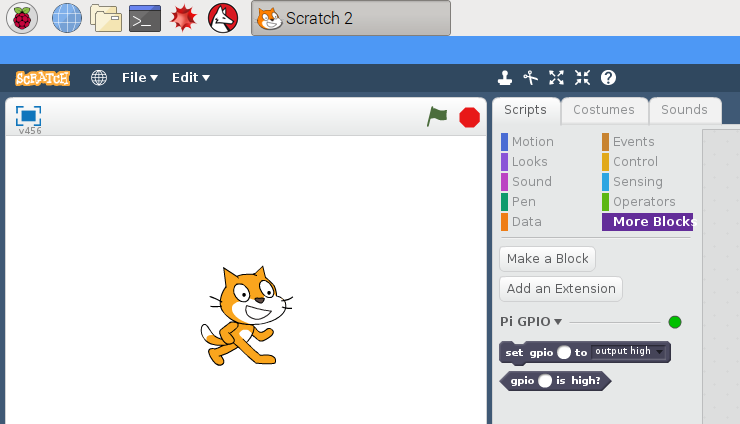
Raspberry Pi is a single-board computer designed to teach basic computer science. The Raspberry Pi is small board that attaches to the computer to be used with coding programs such as Python or Scratch. On the Raspberry Pi, there is a row of GPIO (general-purpose input/output) pins along the top edge of the board. Any of the GPIO pins can be designated as an input or output and used for a wide range of purposes. For more information on setting up a Raspberry Pi device visit <https://projects.raspberrypi.org/en/pathways/getting-started-with-raspberry-pi>.

**Materials:**

* Raspberry Pi
* Breadboard
* Jumper Wires
* LED lights

**Instruction**

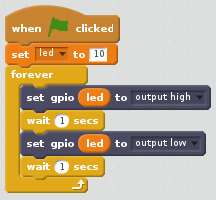
***Part 1*** (20-30 min)

* Students will connect an LED to GPIO pin 10 with a jumper cable. They will use a resistor to limit power between the ground wire and the LED.
* Students will open up Scratch 2 in the Raspberry Pi.
* Open the More Blocks panel, click Add an Extension, and select Pi GPIO. You should then see two new blocks appear:
* You can use these two purple blocks to control output pins or read input pins by entering the pin number into the field, or using a variable containing the pin number:





* To control an LED connected to GPIO10, you can use these blocks:



* Click the green flag, and the LED will blink on and off repeatedly.

*Discuss:*

1. How the light is blinking?
2. What the code is telling the computer to do?

***Part 2*** (30 minutes)

* Have students open up Python on the Raspberry Pi.
* Under file > New
* Have the students copy the Python code for an LED light:
  + from gpiozero import LED
  + from time import sleep
  + led = LED(10)
  + while True:
    - led.on()
    - sleep(1)
    - led.off()
    - sleep(1)
* Have students run the code and watch what happens.

*Discuss and Compare:*

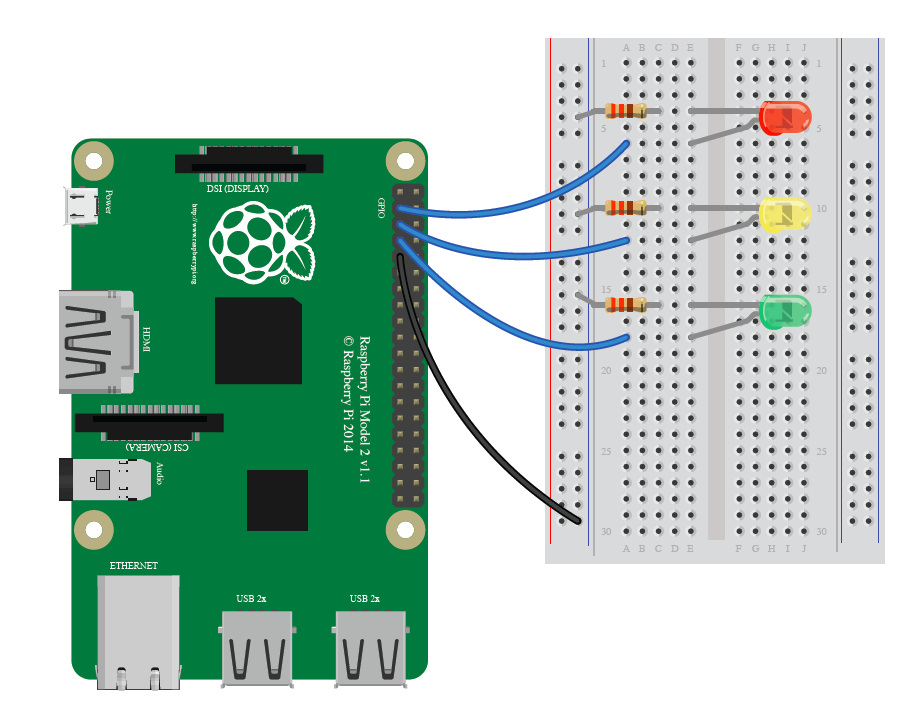
1. How are Scratch and Python similar? Different?
2. What is the Python code telling the computer to do?

\*At this point, the students are not being taught Python coding, rather they are being given a piece of code that will light a LED light. The teacher should explain how there is a syntax to all coding languages including Python. Indentations and capitalization are very important in coding to let the computer know what you want it to do.

***Extension***

1. Students should now be able to add more lights and experiment with different light patterns.
2. Can the students make a stop light?
3. Can you create a pattern based on a beat?
4. Can you add a button to turn on the light?

*Example*: Traffic Light



*Closure:*

At the end of the lesson, students should be able to use code (Scratch or Python) to light LED lights connected to the Raspberry Pi. Students should be able to understand how to add more lights and control them.

Have a discussion with the students as to what they can create by using external devices like buttons, buzzers and sensors. How can they control these devices to create a security system or a door ajar warning? What else can the students think of that these GPIO pins and coding could do?

**Differentiation**

* The teacher should determine groups based on student ability level.
* Students who excel in this lesson may continue with the optional extension.

**Assessment**

*Formative*

* The students should have informal discussions throughout the lesson. The teacher should walk throughout the class and monitor discussions to ensure students understand discussion questions.
* Students should be able to connect the LED lights to a breadboard and run code to light the LEDs. The teacher should monitor the students to ensure that all students have followed instructions and have met expectations for this lesson.