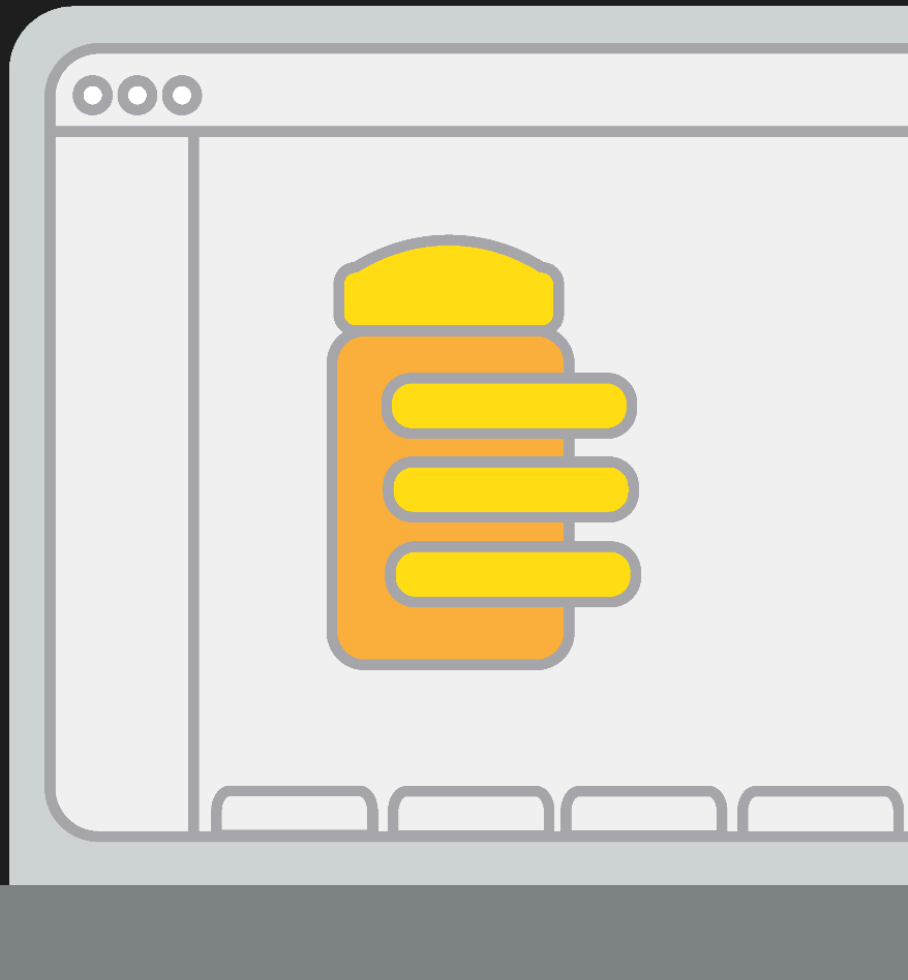


**P I P E R**

# PLAYBOOK

PIPER MAKE













# WELCOME, MAKER

Welcome to the **Piper Make Playbook** for students in grades 3 - 8! This 40 hour playbook features a series of carefully curated computer science enrichment projects designed to support learning.

Piper Make is standards aligned and can be used during enrichment time to instill 21st-century skills through STEAM problem solving, engineering design, and develop computational thinking. No experience is required for the teacher or student. We pride ourselves in delivering access, equity and inclusion in our instructional programs.

This guide is broken into **10 different career-connected playbooks** which can be found individually on the [Piper Make Curriculum page](#).

The sections are as follows:

 6-7 hrs	<b>Basic Circuits and Coding</b>	Build and code basic circuits using the Raspberry Pi Pico microcontroller
 4-5 hrs	<b>Explore with Sensors</b>	Use a color sensor, ultrasonic range finder, and temperature sensor to measure the world around you.
 4-5 hrs	<b>Introduction to Gaming</b>	Build a working game controller and use it to play games you code yourself.
 5-6 hrs	<b>Introduction to Robotics</b>	Build and code two mechanical robots to use motors and sensors to move.
 2-3 hrs	<b>Creating Art with Technology</b>	Use a 8x8 LED matrix to create designs and messages to display and share.
 1-3 hrs	<b>Understanding Clean Energy</b>	Understand how technology can interact with our natural environment to power our devices and to measure our impact.
 2-3 hrs	<b>Introduction to Biomedical Technology</b>	Build a functioning pulse sensor and measure your heart rate.
 1-3 hrs	<b>Kinetics and Motion</b>	Explore how to use technology to measure how objects move in space.
 2-3 hrs	<b>Basics of Cybersecurity</b>	Explore cybersecurity basics, like privacy protection and encryption fundamentals.
 1-2 hrs	<b>Invent with Learned Skills</b>	Reflect on learned skills during your Piper Make build and coding challenges and apply them in our Piper Make-a-Thon to invent technology solutions to the problems you experience in the world around you.

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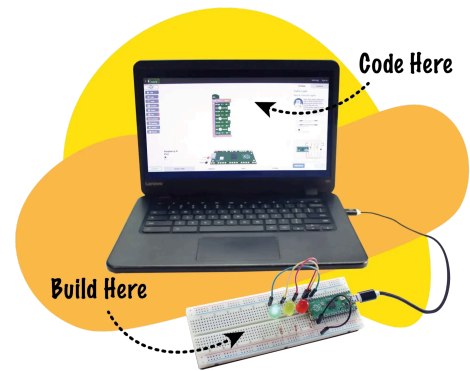
## WHAT IS PIPER MAKE

Piper Make is our integrated hardware and software platform that provides a learning tool to innovate at home or in the classroom. We blend **basic hardware kits with our cloud-based, drag-and-drop coding software** to allow students to explore building with the Raspberry Pi Pico microcontroller.

There are two parts to the Piper Make experience.

**Hardware:** Widgets are available for purchase on our website at [playpiper.com](https://playpiper.com) and are designed to require a build with an engineering blueprint.

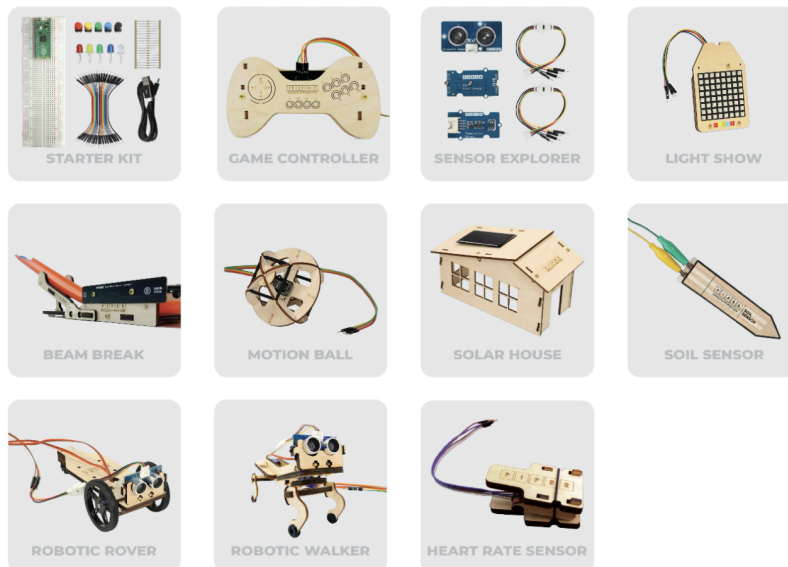
**Software:** Once constructed, the interaction Mission Control guides students to learn about prototyping design, math, and science concepts, engineering design methods, and computational thinking and coding with Blockly (a block-based programming language)



All content is standards-aligned and designed to be self-guided.

## WHAT ARE WIDGET ADD-ONS?

Widgets are the hardware projects for Piper Make, which can be purchased on [playpiper.com](https://playpiper.com). Each **WIDGET** has **MISSIONS** associated with it. Career-connected missions on Piper Make Mission Control make up an **EXPEDITION**. New widgets and missions may be added regularly! For the most up-to-date list head to: <https://www.playpiper.com/pages/piper-make>



## WELCOME TO MISSION CONTROL

Piper Make Mission Control is used to refer to the online platform where you can interface your hardware with the browser-based software to code. The platform includes career-connected missions, Google integrations, and more.

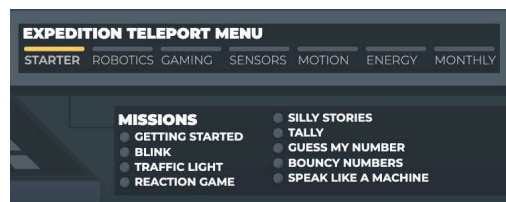
⚠ To access it, go to [MAKE.PLAYPIPER.COM](https://MAKE.PLAYPIPER.COM) on your Chrome browser.

### WHAT ARE THE EXPEDITIONS?

Piper Make widgets are designed to fit into career-connected missions that form cohesive expeditions—whether Energy or Design or more. On Mission Control, you can toggle between the Expeditions in the bottom pane (bottom panel in red)]:



You can use this bottom panel to see each of the missions in the expedition. For the Piper Make Starter Kit Expedition, you can select the missions from the panel or from the individual tiles.



### WHAT ARE THE GOOGLE TOOLS?

In addition to Google Single-Sign On, some of the key tools are built into each mission tile. You can access educator guides, download code, and share tutorials:



## WHAT IS CREATIVE MODE?

Creative Mode allows you to create new projects. A new project is a blank canvas for you to complete our **Maker's Challenges** or create whatever you want. To access Creative Mode, flip the switch in the lower right corner and then either **IMPORT** projects (PNG files that you shared) or **CREATE NEW** projects.



## HOW DO I USE THIS GUIDE?

Within each section of this guide, you will find **objectives, standards alignment, career connections** (with links to relevant videos from CareerOnestop when you click on each), and vocabulary. Each guide includes three sections:

1. **Introduction** - With prep questions and content to guide your learners in thinking about the focus area and careers that will be explored in the expedition
2. **Exploration Activities** - These include missions that can be found on Piper Make Mission Control as well as other hands-on activities to guide learning. There are a few markers throughout the guides: ⚠️ = **Note**, 🛠️ = **Essential Skill**, 🔗 = **Link to Real World**
3. **Closing** - These include guiding questions for discussion that will allow students to internalize the standards that have been reviewed in each.

There are a number of buttons to educator guides and worksheets throughout the playbook, so be sure to click on any buttons you see to access the links!

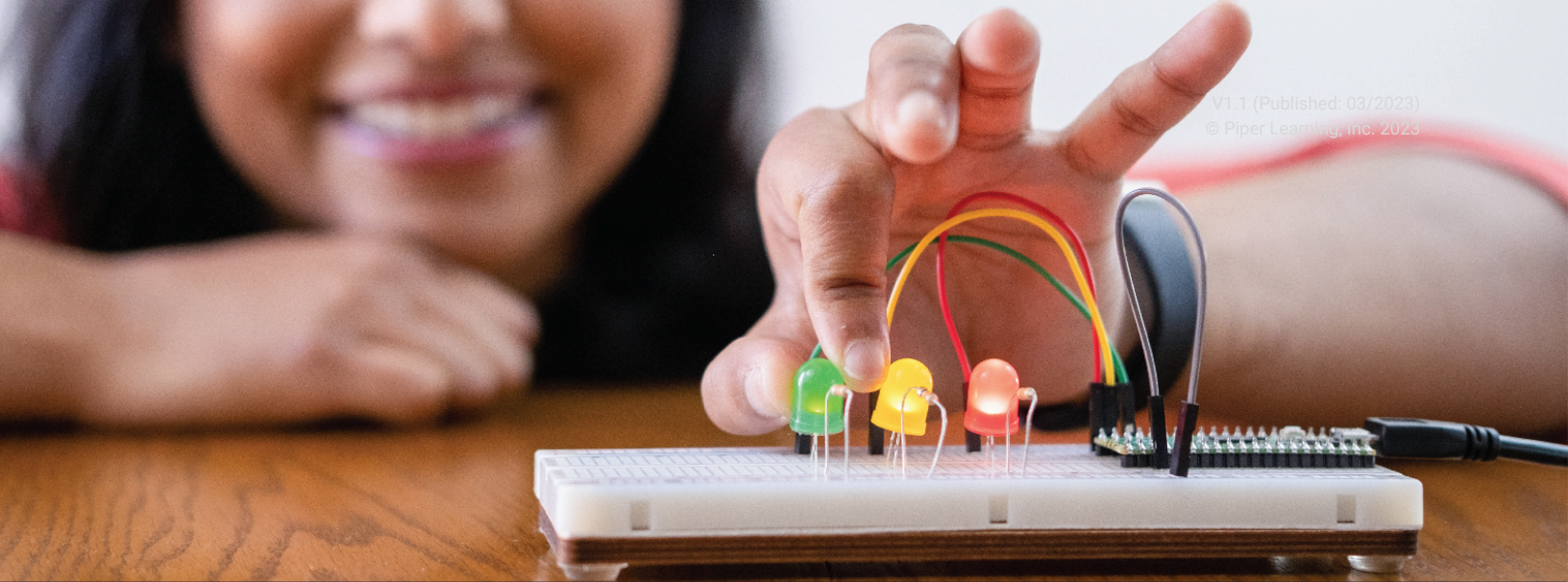
## WHERE DO I GET HELP?

We're excited to help you get started. A particularly great resource are our support pages:

PIPER MAKE MISSION CONTROL SUPPORT

ALL SUPPORT

If you have any questions or need any help troubleshooting, please reach out to us at [hi@playpiper.com](mailto:hi@playpiper.com). If you have any questions about purchasing for your classroom or program, please contact [sales@playpiper.com](mailto:sales@playpiper.com)



STARTER EXPEDITION

# BASIC CIRCUITS AND CODING

🕒 6-7 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit | 9 Missions

**OBJECTIVES:** Build and code basic circuits using the Raspberry Pi Pico microcontroller

## CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Software Developer**  
Avg Salary: \$120,730

**Electrical Engineer**  
Avg. Salary:  
\$100,420

**Data Scientist**  
Avg. Salary:  
\$100,910

**Construction Manager**  
Avg. Salary: \$98,890

## STANDARDS:

- ★ **3-5.CS.2:** Demonstrate how computer hardware and software work together as a system to accomplish tasks.
- ★ **3-5.AP.12:** Create programs that include events, loops, and conditionals.

## VOCABULARY:

**Circuit** - A conductive path for flow of current or electricity

**Power** - The current or flow of electric charge and voltage

**Microcontroller** - An integrated circuit that contains a microprocessor along with memory and associated circuits

**Loops** - A sequence of instructions that is continually repeated until a certain condition is reached

**Variables** - A value that can change, depending on conditions or on information passed to the program

**Input Device** - A hardware device that sends data to a computer, allowing interaction and control

**Output Device** - A piece of hardware which converts information into a human-perceptible form

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## INTRODUCTION

🕒 30 min

Welcome to Piper Make – your integrated experience with building technology and coding it, all from your own USB-connected laptop. Once you open your kits, navigate to **Piper Make Mission Control** (make.playpiper.com) on your Chrome browser.

### DISCUSSION

Start by asking your students how they interact with technology on a daily basis. How do they input information into their technology? What type of output does their technology create?

Ask students to divide into groups and ask them to brainstorm a career of interest to discuss. For each career, ask the group to think of a technology that has advanced the field? How does it work? Here is a handy guide for a few common careers often discussed:

Career	Technology	How it Works
<b>Retail Sales/Waiters</b> →	Point-of-Service Systems	Handheld POS systems talk to cloud databases to calculate and register transactions with money.
<b>Nurse/Medical Professional</b> →	Medication Pumps	The machine's spinning rotors squeeze the tubing that medicine is flowing through to control how fast and how much is given.
<b>Teacher</b> →	Online Classrooms	Give your teachers a round of applause! Teachers are often using online tools as well as elaborate camera setups to teach!
<b>Auto Mechanic</b> →	Electrical Car Components	Electrical cars rely on rechargeable batteries and programs that are written into the "computer" of the electrical motor.
<b>Food Prep Workers</b> →	Sensors to Measure Weights/Inventory	To measure how much of any given stock is, precise weight scales and other sensors are necessary.
<b>Construction Worker</b> →	Heavy Machinery	Automated robots can now be programmed to precisely execute some of the heavy lifting done in construction work.

Now it's time to dive into the basic concepts of those technologies – let's get started!

**⚠️ Prep Tip:** Some USB cables are CHARGE only, which will not work with Piper Make. Ensure you are using the DATA cable in the kit.



## EXPLORATION ACTIVITIES

🕒 5-6 hrs

### MISSION 1

#### GETTING STARTED

The team is ready for Piperbot's Mission to Mars – but it seems Piperbot can't move! Can you build your first circuit and code it to help Piperbot move? This will serve as the introduction to the **Raspberry Pi Pico**, the Piper Make microcontroller, and how it connects to Mission Control.

🔧 **Essential Skill:** Loops in Code

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

### MISSION 2

#### BLINK

Piperbot's made it to Mars but can't see where to land. Help Pip signal to him by building a circuit with an LED and code it to blink. This mission walks through the basics of current and how it flows and how code can be used to control it.

🔧 **Essential Skill:** Cathode, Anode, Current

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

### MISSION 3

#### TRAFFIC LIGHT

Piperbot and Pip are dealing with an intergalactic traffic jam! In this mission, students will build a series of LEDs and program them to light up in specified ways, introducing hardware inputs and outputs as well as coded elements like time delays, sequential triggers, and code loops.

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

🔗 **CHALLENGE:** How would you add a button to allow a pedestrian to cross your traffic light?

### MISSION 4

#### REACTION GAME

Who has faster reflexes – Piperbot or Pip? Or better yet, between your students? In this mission, build and code an LED to light up at a random time and measure who is able to press their button faster.

🔧 **Essential Skill:** Conditional Statement (If/then), Variables

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

 **CHALLENGE:** How would you add another button to make it a three person game?

MISSION 5

**SILLY STORIES**

Our scientists back on Earth need to run some simulations! In our take on the classic MadLibs game, students will fill in the spaces of storylines they create themselves. Students will tap into their creativity to create the most interesting, and random silly stories.

 **Essential Skill:** Print Statements, Console

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

MISSION 6

**TALLY**

In this project, students will build a counter with a variable. The counter records how many times a button is pressed. Tally represents a common way that a score is kept in a video game.

 **Essential Skill:** Mathematical Operations in Code

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

MISSION 7

**GUESS MY NUMBER**

In this simple coding challenge, students will create a random number generator and learn to do comparisons after an input is given. This project will teach them the basics of computational thinking and coding logic.

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

MISSION 8

**BOUNCY NUMBERS**

In this project, students will create bouncing numbers to illustrate the Collatz Conjecture.

 **Essential Skill:** Binary Code

MISSION EDUCATOR GUIDE

ASSESSMENT

MISSION WORKSHEET

### MISSION 9

## SPEAK LIKE A MACHINE

In this project, students will explore binary code, a foundational part of computing. Students will try to “speak” a few numbers in machine language, just as computers do.

 **Essential Skill:** Binary Code

MISSION EDUCATOR GUIDE



ASSESSMENT

MISSION WORKSHEET

### MISSION 10 (OPTIONAL)

## RESISTOR PIANO

Take our musical talents to the next level as Piperbot and Pip jam out with their new Adult Zomar buddy on a piano made of resistors. Ask students: “What is your code measuring to know when and what sound to play? How is this different from your ultrasonic Drum?”

 **This mission is a part of the Sensors or Robotics Expeditions**  
 **Essential Skill:** Mathematical Operations with Fractions, Series Circuits

MISSION EDUCATOR GUIDE

ASSESSMENT

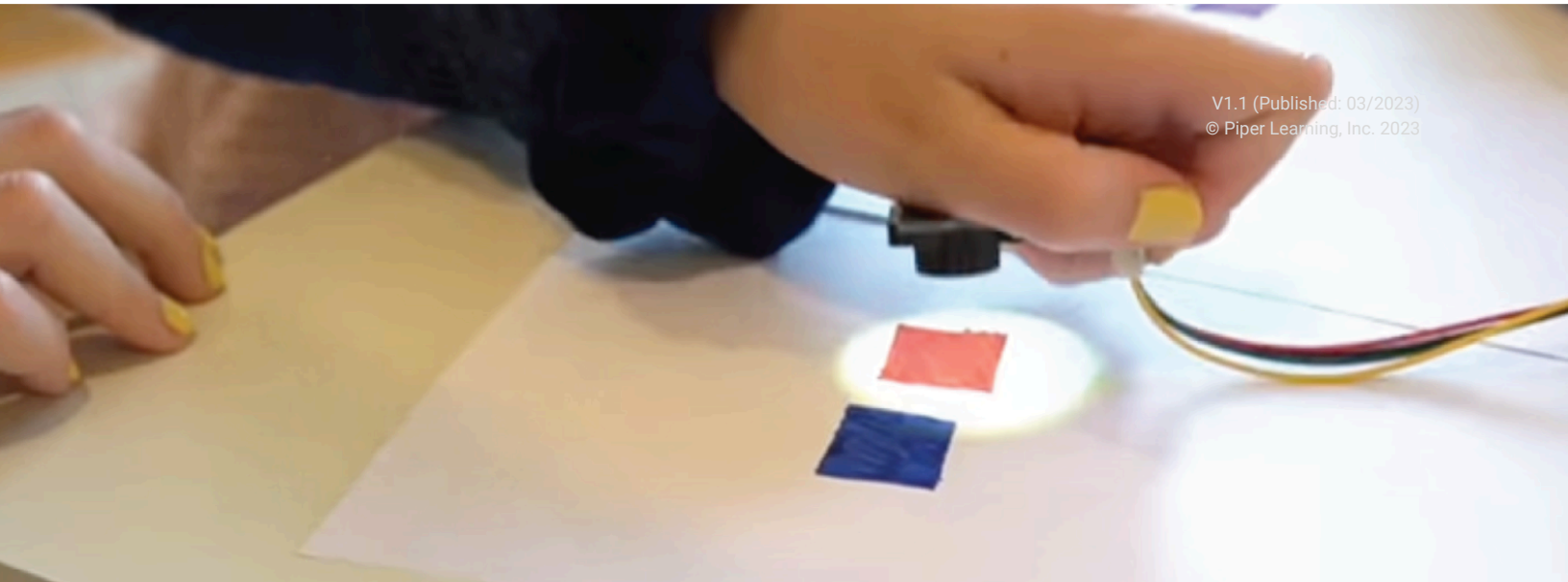
MISSION WORKSHEET

## CLOSING

 15 min

Ask the following questions to guide discussion:

- How did hardware and software interact in the missions you just completed? (CA 3-5.CS.2)
- Which missions did you use loops to code events? What about conditionals? (CA 3-5.AP.12)



## SENSORS EXPEDITION

# EXPLORE WITH SENSORS

🕒 4-5 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit, Piper Sensor Explorer | 5 Missions

**OBJECTIVES:** Use a color sensor, ultrasonic range finder, and temperature sensor to measure the world around you.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Remote Sensing  
Technician**  
Avg Salary: \$49,030

**Security/Fire  
System Installers**  
Avg. Salary: \$48,320

**Computer  
Hardware Engineer**  
Avg. Salary: \$128,170

**Hydrologic  
Technician**  
Avg. Salary: \$62,280

### STANDARDS:

- ★ **CA 3-5.CS.1** Describe how computing devices connect to other components to form a system. (P7.2)
- ★ **3-5.AP.18** Perform different roles when collaborating with peers during the design, implementation, and review stages of program development.

### VOCABULARY:

**Engineer** - A person trained to design and build machines and structures

**Sensor** - Device that produces an output signal for the purpose of sensing a physical phenomenon

**Conditional Statement** - A type of coding instruction used to compare values and express and make decisions, like an if-then statement

**List** - Sequence of several variables, grouped together under a single name in code

## INTRODUCTION

🕒 30 min

In this expedition, we will be using three sensors (Color Sensor, Ultrasonic Range Finder, and Temperature Sensor) to explore how technology can respond to and interact with the world around us.

### DISCUSSION

To start, have a discussion in your classes regarding how humans sense the world around them. Ask students: **“What are the five senses? What is your understanding of how those senses work?”**. Get learners thinking about how technology could detect the same functions. Here is a handy table to guide this conversation:

Human Sense	How the Body Works	Connection to Technology
<b>Sight</b>	→ The <b>retina in the back of the eye</b> has rods and cones that detect reflected light and turn it into nerve impulses that we interpret as sight.	The <b>Color Sensor</b> that you will use is similar to cones in your eye, it detects the wavelength of reflected light and interprets it as different colors!
<b>Sound</b>	→ Sound waves traveling through the air hit our <b>eardrums</b> , causing them to vibrate the bones of the middle ear, transmitting nerve impulses that we interpret as sound.	The <b>Ultrasonic Range Finder</b> emits sound waves which bounce off objects near it and can be picked up by the sensor, like an eardrum!
<b>Smell</b>	→ Olfactory (or smelling) neurons have <b>receptors for unique microscopic particles</b> (tiny particles of coffee, trash, etc.) floating in the air, which when activated, we interpret as smell.	Most homes have <b>Carbon Monoxide Sensors</b> that work the same way – microscopic particles of carbon monoxide in the air react with the sensor and cause an alarm to go off!
<b>Taste</b>	→ <b>Taste buds on your tongue</b> (along with those olfactory neurons!) are activated by chemicals in different foods that tell your brain whether something is salty, sweet, sour, or something else.	We don't have virtual food yet but people are developing technological tongues! We can measure individual tastes – like how much salt is dissolved in some water with a <b>Salinity Sensor</b> .
<b>Touch</b>	→ <b>Sensors close to the surface of the skin</b> detect when we are touching anything and whether it's hot/cold – there's especially a ton near your fingertips and lips.	The <b>Temperature Sensor</b> basically acts like the temperature sensors in your skin to detect if something is hot/cold.

Next, head over to the Sensor Expedition on Mission Control to start the missions. Note Missions 1-3 (Security Zone, Ultrasonic Drum, and Resistor Piano) are also included in the Robotics Expedition.

## EXPLORATION ACTIVITIES

🕒 3-4 hrs

### MISSION 1

#### SECURITY ZONE\*

In this mission, you will help Piperbot and Pip detect when a perimeter is breached using the Ultrasonic Range Finder and set off an alarm. Ask students: "What do you think security systems in homes use as the sensor? What about smart doorbells?"

 **Essential Skill:** Conditional (if/then) Statements in Code, Distance as an Input

MISSION EDUCATOR GUIDE


MISSION WORKSHEET

### MISSION 2

#### ULTRASONIC DRUM\*

Piperbot and Pip need help soothing the baby Zomar to sleep! Play your Ultrasonic Range Finder as an instrument to help. Ask students: "How does your instrument know when and what sound to play? How does an electric keyboard know how to make a sound?"

 **This is like a Theremin – check out this cool instrument in action!**

 **Essential Skill:** Lists in Code, Mapping in Code

MISSION EDUCATOR GUIDE


MISSION WORKSHEET

### MISSION 3

#### RESISTOR PIANO\*

Take our musical talents to the next level as Piperbot and Pip jam out with their new Adult Zomar buddy on a piano made of resistors. Ask students: "What is your code measuring to know when and what sound to play? How is this different from your ultrasonic Drum?"

 **This mission is an OPTIONAL mission for the Starter Kit**

 **Essential Skill:** Mathematical Operations with Fractions, Series Circuits


MISSION EDUCATOR GUIDE

MISSION WORKSHEET

### MISSION 4

#### THER-MOOD-STAT

Head back to Earth to help our scientists create a temperature-sensing suit! Ask students: "Where do you think detecting temperature is important? Other than emojis, what response could you code?"

 **Essential Skill:** Temperature as an Input

MISSION EDUCATOR GUIDE

VIDEO GUIDE FOR EDUCATORS

MISSION WORKSHEET

*\*Note: Security Zone, Ultrasonic Drum, and Resistor Piano are also included in the Robotics Expedition.*

MISSION 5

**COLOR CODED**

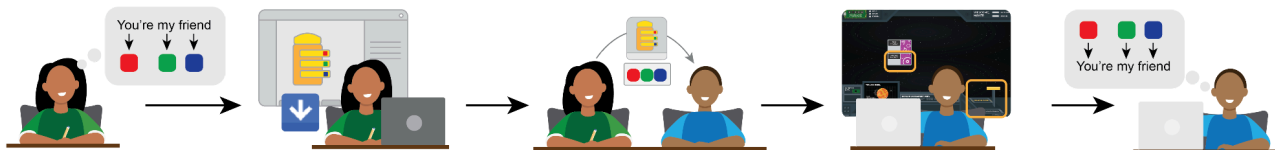
Help Piperbot and Pip get into the Maker’s City by decoding the color sequence from the Color Wheel. Ask: “How does the Color Sensor interpret color from light that is bouncing back to the sensor? Can it tell between different shades of the same color?”

**! BONUS:** Use the same code to decode the color sequence on Piperbot’s front panel!  
**! Essential Skill:** Color as an input

MISSION EDUCATOR GUIDE

MISSION WORKSHEET

**OPTIONAL:** Curious about how you can use color as a code to send your own messages? Use the following steps to facilitate learning in the classroom:



(1)  
Have students think of a secret message and map each word to different colors.

(2)  
Ask your students to create code that they may download and share with a partner.

(3)  
Ask your students to draw the color sequence for the message and hand it to their partner.

(4)  
The partner can then upload the code (in Piper Make Creative Mode)

(5)  
The partner can use the Color Sensor to “read” the code.

**! This OPTIONAL challenge is included in the Cybersecurity Playbook**

MISSION 6

**HEART RATE SENSOR**

In this mission, Piperbot and Pip find themselves on a new, swampy planet that makes Pip tired! To figure out if Pip’s pulse has slowed down, you build a heart rate sensor and use it to measure your

pulse. Ask your students: How does the sensor measure pulse? Can you see the green light? How does that work differently on lighter and darker skins?

 **Essential Skill:** Diversity in Creating Technology

## HEART RATE SENSOR BLUEPRINT

## MISSION EDUCATOR GUIDE

### (OPTIONAL) ULTRASONIC RANGE FINDER AS ULTRASOUND

This OPTIONAL mission is not a Piper Make mission but rather an illustration of how ultrasound can be used in medicine. All you need is a few sheets of graph paper, scissors, and tape:



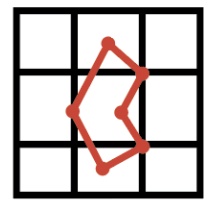
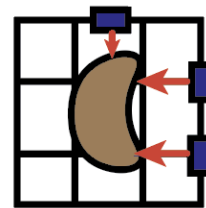
Cut out a kidney shape and a strip



Tape them together



Place kidney on graph paper

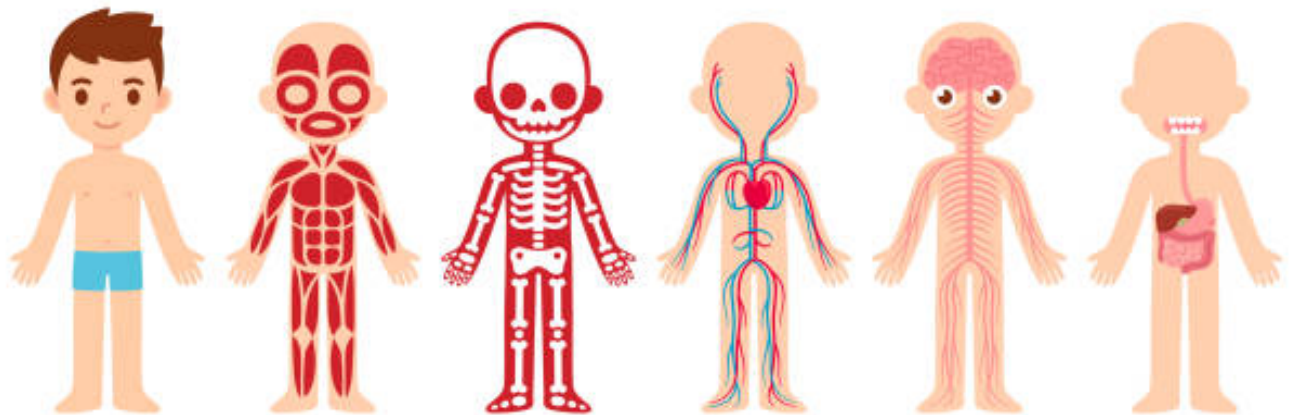


Measure distance to kidney, have another student trace measurements onto another sheet

 This OPTIONAL challenge requires the **ULTRASONIC RANGE FINDER (Sensors or Robotics)**.

### EXPLORE AND BRAINSTORM

There are so many things our bodies are able to do and when something goes wrong, that's what leads to people being very sick! Luckily we've figured out how to use technologies to study some:





Organ System	Muscular	Skeletal	Circulatory	Nervous	Digestive
<b>What Does the System Do?</b>	Moves the body, gives it posture and circulates the blood	Support the body, protects soft organs inside	Carries oxygen and nutrients to and remove waste from organs	Controls everything you do (breathing, walking, thinking)	Process what you eat into fuel for your body and waste
<b>Technologies Used to Study</b>	Electromyogram (EMG): measures when muscles contract	X-rays: a wave of high energy that is measured as a picture after going through bone	Pulse Oximeter, EKG: Measures how much blood is in the arteries or the electrical activity of the heart	Electroencephalogram (EEG): Measures the electrical impulses through different parts of the brain	Capsule endoscopy: A tiny camera that people swallow that you can use to see blockages or bleeding!

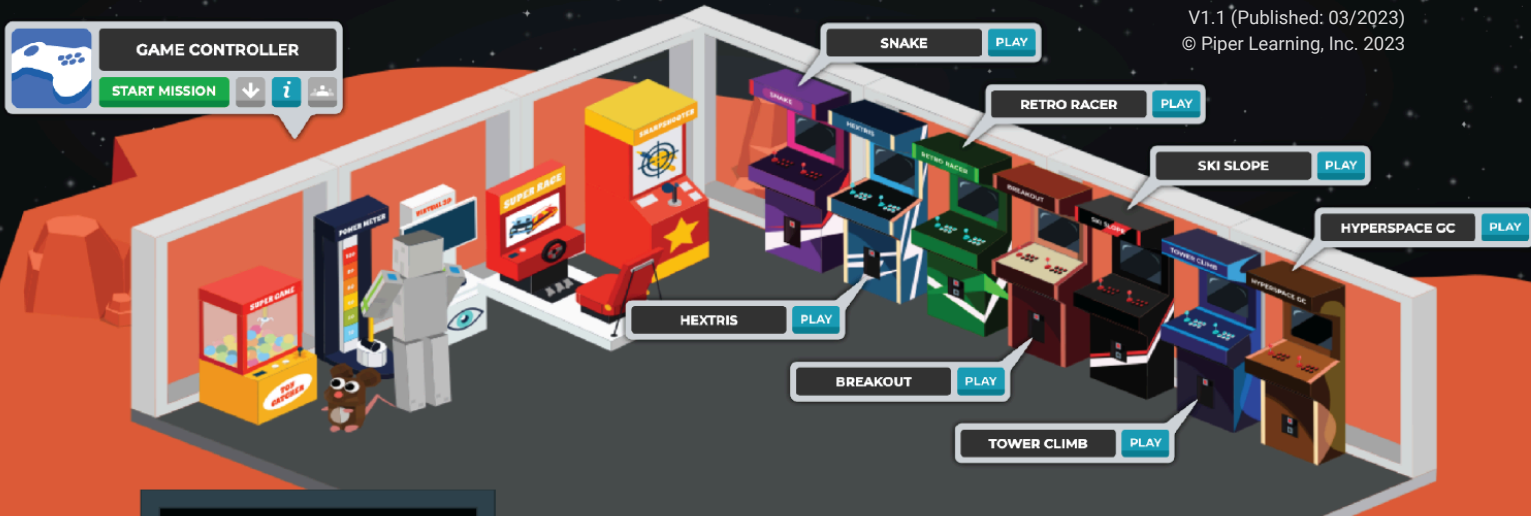
Can you think of other ways to study some of the cool things your body can do?

## CLOSING

🕒 30 min

Ask the following questions to guide discussion:

- What were the different computing devices you connected in this expedition? **(CA 3-5.CS.1)**
- How did you decide who did what in your teams during the build? **(3-5.AP.18)**



## GAMING EXPEDITION

# INTRODUCTION TO GAMING

🕒 4-5 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit, Piper Make Game Controller | 3 Missions + 9 Mini-Games

**OBJECTIVES:** Build a working game controller and use it to play games you code yourself.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Software Quality Assurance Analysts**  
Avg. Salary: \$98,220/yr

**Web and Digital Interface Designers**  
Avg. Salary: \$79,890/yr

**Computer User Support Specialists**  
Avg. Salary: \$49,770/yr

**Video Game Designers**  
Avg. Salary: \$90,270/yr

### STANDARDS:

- ★ **CA 3-5.AP.14** Create programs by incorporating smaller portions of existing programs, to develop something new or add more advanced features.
- ★ **CA 3-5.AP.12** Create programs that include events, loops, and conditionals.
- ★ **CA 3-5.AP.11** Create programs that use variables to store and modify data.

### VOCABULARY:

**Console** - Personal computers built for gaming (e.g., PlayStation, Xbox, Nintendo Switch)

**Modding** - Making "modifications" to how a game sounds, how it plays, looks, or functions, usually by users

**Graphic User Interface (GUI)** - A way to display information on the computer screen where the user can use a mouse to click on buttons to do things.

**Playtesting** - Playing through new builds to find bugs, ensure flow, and get new ideas to build on

**Virtual reality (VR)** - Computer technology that makes a person feel like they are somewhere else, requires players to wear a headset and use input devices to play games

## INTRODUCTION

🕒 15 min

In this playbook, we will build a working game controller and use it to play games you code yourself.

### START WITH THE BUILD

This is an interesting build as there is a **printed circuit board assembly (PCBA)** which is board design with a base board and copper traces to maintain connectivity between electronic components such as LED's, integrated circuits and resistors for your devices. Trace those connections on your own!

WATCH THE BUILD

## EXPLORATION ACTIVITIES

🕒 3-4 hrs

### MISSION 1

#### LIGHTHOUSE

Back on Earth, our scientists have noticed a ship heading towards their lighthouse! As a simple introduction to the buttons on the PCBA, in this mission, your students build and code an Traffic Light-like series of LEDs that can be controlled by your button presses.


 **Essential Skill:** Conditional Statements

MISSION EDUCATOR GUIDE

### MISSION 2

#### FROG FRENZY

It appears that the Earth team has lost connection to a mining ship on Pipax but our scientists have scrambled to get a primitive view and mining control back up! In this mission, code a game where ore randomly appears and use your controller to play.

 **Essential Skill:** Variables, Mathematical Operations in Code

MISSION EDUCATOR GUIDE

### MISSION 3

#### GAME CONTROLLER

Moment of truth! Let's wire everything up and get each button mapped to code to allow it to play. This game controller mission is a complex coding exercise, but will allow you to play all the mini-games!

 **Essential Skill:** Functions, Conditionals

GAME CONTROLLER V1 BLUEPRINT

GAME CONTROLLER V2 BLUEPRINT

MISSION EDUCATOR GUIDE

### MISSION 4

#### MINI-GAMES

With seven mini-games in Pip's Arcade, it's time to use our Minecraft Controller to play! These games include: **Snake, Retro Racer, Ski Slope, Hyperspace GC, Hextris, Breakout, and Tower Climb.** If you

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have any trouble using the controller with the game, open Minecraft Controller in another tab, hit START and then navigate back to your mini-game.

#### MISSION 5

### **(OPTIONAL) MINECRAFT CONTROLLER**

You can use your Piper Make Game Controller to play Minecraft Education Edition, if your school has an active subscription. Map the buttons of your PCBA to the keyboard buttons that are usually used and then get started.

 **This mission REQUIRES a license for Minecraft or Minecraft Education Edition (NOT INCLUDED)**  
 **Minecraft Education Edition has some great context!**

## CLOSING

 30 min

Ask the following questions to guide discussion:

- What were the individual tasks you broke your large blocks of code into? **(CA 3-5.AP.14)**
- Where did you use events, loops, and conditionals in your code? **(CA 3-5.AP.12)**
- What were the variables you used in the games that you created? What about your controller code? **(CA 3-5.AP.12)**



## ROBOTICS EXPEDITION

# INTRODUCTION TO ROBOTICS

🕒 5-6 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit, Piper Make Rover, Piper Make Walker | 1 Missions

**OBJECTIVES:** Build and code two mechanical robots to use motors and sensors to move.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Robotics Technicians**  
Avg Salary: \$71,500/yr

**Automotive Engineers**  
Avg Salary: \$95,300/yr

**Civil Engineers**  
Avg Salary: \$88,050/yr

**Electro-Mechanical and Mechatronics Technologists**  
Avg Salary: \$60,360/yr

### STANDARDS:

- ★ **CA 3-5.AP.17** Test and debug a program to ensure it accomplishes the intended task.
- ★ **CA 3-5.CS.2** Demonstrate how computer hardware and software work together as a system to accomplish tasks.
- ★ **CA 3-5.CS.3** Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.

### VOCABULARY:

**Robot** - A device that can execute a task independent of direct human control or activity

**Feedback Sensors** - Instruments that robots can use to adjust based on the environment

**Servo Motor** - Self-contained electric devices that precisely rotate or push parts of a machine

**Autonomous vehicle** - Vehicle that can operate without direct human control, usually through a built-in autopilot system

**Bionics** - Using biological systems (e.g., dogs, humans) for the development and design of new robots

## INTRODUCTION

🕒 15 min

In this playbook, students will learn to build and code two mechanical robots to use motors and sensors to move. This introduction to robotics is a good time to discuss the role of robotics in our current workforce, how they are designed, and considerations in how they might work.

To prepare, ask students: What do you think of when you hear the word “robot”? What sort of functions can robots do well? How do you think those robots are designed? Can you think of where robots are useful or not useful?

## EXPLORATION ACTIVITIES

🕒 4-5 hrs

### MISSION 1

#### SECURITY ZONE\*

In this mission, you will help Piperbot and Pip detect when a perimeter is breached using the Ultrasonic Range Finder and set off an alarm. Ask students: “What do you think security systems in homes use as the sensor? What about smart doorbells?”

 **Essential Skill:** Conditional (if/then) Statements in Code, Distance as an Input

MISSION EDUCATOR GUIDE


MISSION WORKSHEET

### MISSION 2

#### ULTRASONIC DRUM\*

Piperbot and Pip need help soothing the baby Zomar to sleep! Play your Ultrasonic Range Finder as an instrument to help. Ask students: “How does your instrument know when and what sound to play? How does an electric keyboard know how to make a sound?”

 **This is like a Theremin – check out this cool instrument in action!**

 **Essential Skill:** Lists in Code, Mapping in Code

MISSION EDUCATOR GUIDE

MISSION WORKSHEET

### MISSION 3

#### RESISTOR PIANO\*

Take our musical talents to the next level as Piperbot and Pip jam out with their new Adult Zomar buddy on a piano made of resistors. Ask students: “What is your code measuring to know when and what sound to play? How is this different from your ultrasonic Drum?”

 **This mission is an OPTIONAL mission for the Starter Kit**

 **Essential Skill:** Mathematical Operations with Fractions, Series Circuits

MISSION EDUCATOR GUIDE

MISSION WORKSHEET

*\*Note: Security Zone, Ultrasonic Drum, and Resistor Piano are also included in the Sensors Expedition.*

#### MISSION 4

### WALKER RACE

Piperbot and Pip have created a pretty convincing robot to enter the Mars Creature Race for the Cause – now it's time to put it to the test! In Event 1, your students will build and code the Walker, a quadruped robot to walk (and run!) like a dog.

 **Essential Skill:** Servo Motors as Output, Angles to Determine Motion


WALKER V1 BUILD GUIDE

WALKER V2 BLUEPRINT

#### MISSION 5

### WALKER DANCE

Next up for Walker, it's time to dance! In this mission, code a recurring loop to make Walker dance back and forth to the beat of your favorite song.

 **Essential Skill:** Wait Times in Code


MISSION EDUCATOR GUIDE

WALKER DANCE VIDEO

#### MISSION 6

### WALKER DETECT

And last up, it's time for final judging. In this mission, you'll make sure Walker does walk into the judging table by using the Ultrasonic Range Finder to detect when it's up against an obstacle.

 **Essential Skill:** Feedback Sensors as Binary Inputs

MISSION EDUCATOR GUIDE

WALKER DETECT VIDEO

#### MISSION 7

### RUNAWAY ROVER

The Zomars are onto Piperbot and Pip after Walker's stunning win in the Race for the Cause! Now we've got an angry mob of Zomars that we've got to escape – thank goodness we've found the parts to build a vehicle to get away. Build and code your Runaway Rover and learn how to move and turn.

 **Essential Skill:** Rotational Motion

ROVER V1 BUILD GUIDE

ROVER V2 BLUEPRINT

MISSION EDUCATOR GUIDE

RUNAWAY ROVER VIDEO

## MISSION 8

### ROVER SENSOR STEERING

Piperbot is too scared to look! Instead of using code to steer our Rover, we'll use the Ultrasonic Range Finder as a distance measurement tool to "drive" the robot.

 **Essential Skill:** Using Sensors as an Variable Input

MISSION EDUCATOR GUIDE

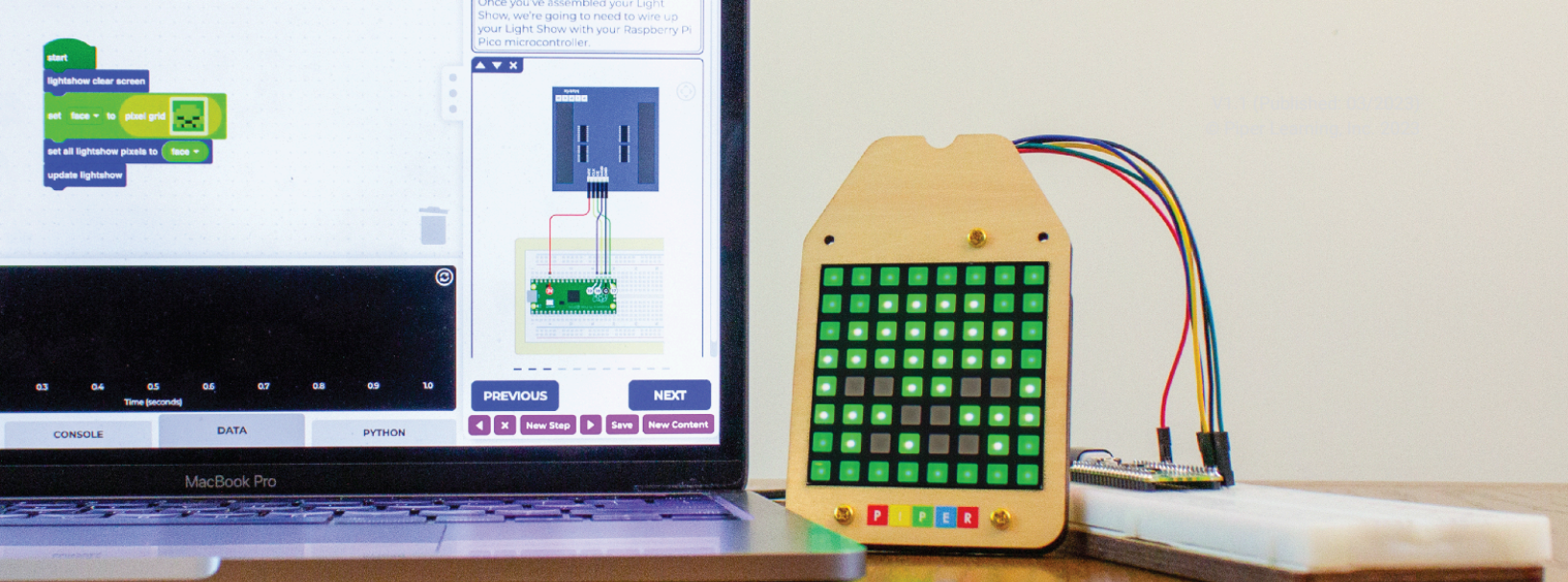
## CLOSING

🕒 15 min

Ask the following questions to guide discussion:

- Did your robots work perfectly the first time you hit START? How did you troubleshoot and debug your program or your hardware? (CA 3-5.AP.17, CA 3-5.CS.3)
- How did your hardware and software work together as a system? What was the task you were trying to accomplish? (CA 3-5.CS.2)





## DESIGN EXPEDITION

# CREATING ART WITH TECHNOLOGY

🕒 2-3 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit, Piper Make Light Show | 1 Missions

**OBJECTIVES:** Use a 8x8 LED matrix to create designs and messages to display and share.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Demonstrators and Product Promoters**  
Avg Salary: \$32,350/yr

**Marketing Managers**  
Avg Salary: \$135,030/yr

**Fashion Designers**  
Avg Salary: \$77,450/yr

**Web and Digital Interface Designers**  
Avg Salary: \$79,890/yr

### STANDARDS:

- ★ **CA 3-5.DA.7** Explain that the amount of space required to store data differs based on the type of data and/or level of detail.
- ★ **CA 3-5.IC.20** Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.
- ★ **CA 3-5.IC.23** Describe reasons creators might limit the use of their work.

### VOCABULARY:

**Pixel** - a shortened form of “picture element”, one of the many tiny dots that make up the representation of a picture in a computer’s memory (resolution is the number of pixels)

**Color Depth** - The amount of color used in computer graphics, usually measured in bits per pixel.

**Medium** - The materials used in creating a piece of artwork such as paint, marble, clay, or pastels.

**Graphic User Interface (GUI)** - A way to display information on the computer screen where the user can use a mouse to click on buttons to do things.

**Animation** - The manipulation of figures that make images look like they are moving.

## INTRODUCTION

🕒 15 min

In this playbook, we will use a 8x8 LED matrix to create designs and messages to display and share. This creative exercise should be an exciting way to talk about how technology is reshaping what we consider “art”. Ask students: What is your favorite work of art (music, painting, etc.)? What is the medium that art was created in? Are there any new ways that technologies can be used to expand those mediums?

## EXPLORATION ACTIVITIES

🕒 1-2 hrs

### MISSION 1

#### LIGHT SHOW

Now it’s your turn! Piperbot and Pip have stumbled across an LED billboard, and they’re up to trouble trying to flash their faces up there. Students will use code to create multicolored art on their 8x8 LED matrices, and explore light as a medium for their designs.

🔧 **Essential Skill:** Understanding Pixels and Bits, Creating 64-Bit Artwork

LIGHT SHOW V1 BLUEPRINT

LIGHT SHOW V2 BLUEPRINT

MISSION EDUCATOR GUIDE

### MISSION 2

#### LIGHT SHOW ANIMATION

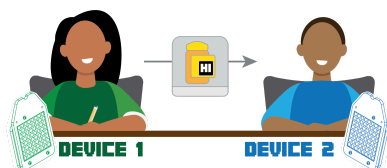
Piperbot and Pip are trying to say hello to the Master Maker’s City! Create a scrolling message with your Light Show, and play around with creating interesting animations that can be looped to create animations and motion with lights.

🔧 **Essential Skill:** Knowledge of wait times and how they affect movement, speed and frame rate

MISSION EDUCATOR GUIDE

🔗 **These are the concepts used in movies too! – [Check out the 12 Basics of Animation](#)**

**OPTIONAL:** Student 1 to create a code with their Light Show and then send it via Google Drive to Student 2. Student 2 can use the “Import” feature in Creative Mode to upload the code and “read” it with their own Light Show.



Discuss how this exchange of information is technically **end-to-end encryption** – as the Light Shows serve as encryption and decryption devices while the intermediate (the PNG code) is technically not readable.

⚠️ **This MISSION is included in the Cybersecurity Expedition**

## CLOSING

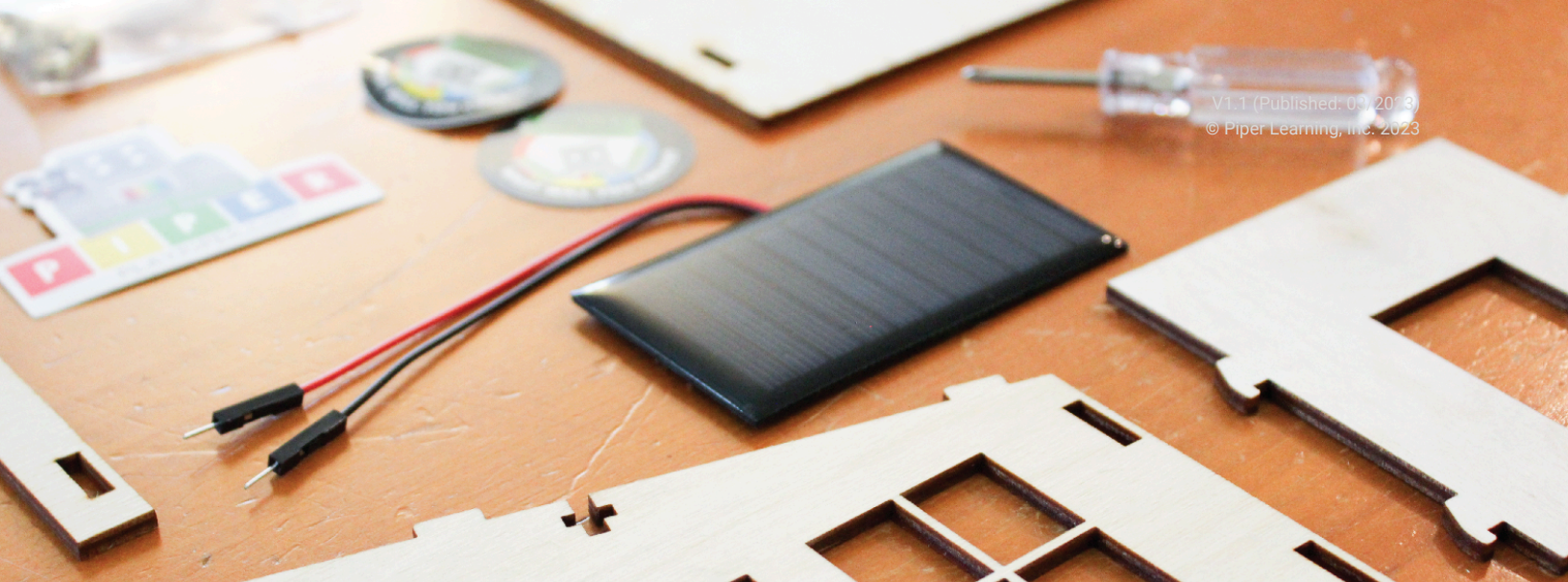
🕒 30 min

Ask the following questions to guide discussion:

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- How quickly do you think a million x million matrix would load compared to your 8x8 Light Show matrix? What if you only had two colors instead of 64? **(CA 3-5.DA.7)**
- Can you imagine how different cultures might create different kinds of art with this medium? What have been computing technologies that have changed the world? **(CA 3-5.IC.20)**
- Why would you or would you not want others to use the art you created with your Light Show? **(CA 3-5.IC.23)**



## ENERGY EXPEDITION

# UNDERSTANDING CLEAN ENERGY

🕒 1-3 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Solar House, Piper Make Soil Sensor | 3 Missions

**OBJECTIVES:** Understand how technology can interact with our natural environment to power our devices and to measure our impact.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

#### Natural Sciences Managers

Avg Salary: \$137,900/yr

#### Agricultural Engineers

Avg Salary:  
\$82,640/yr

#### Environmental Engineers

Avg Salary: \$96,820/yr

#### Soil and Plant Scientists

Avg Salary: \$66,750/yr

### STANDARDS:

- ★ **CA 3-5.CS.2** Demonstrate how computer hardware and software work together as a system to accomplish tasks.
- ★ **CA 4-ESS3** Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment (5.ESS3.C; MS.PS3.D; MS.ESS2.A; MS.ESS3.A; MS.ESS3.C; MS.ESS3.D)

### VOCABULARY:

**Fossil Fuels** - Sources of energy made from prehistoric plants and animals (coal, oil, natural gas).

**Renewable Energy** - Sources of energy from natural resources that can be more easily replenished (solar, water, nuclear).

**Capacitance** - The ability of a component to store an electrical charge

**Pollution** - Anything that dirties the Earth like litter, smoke from cars/factories, or water contamination.

## INTRODUCTION

🕒 15 min

In this playbook, we will be learning the fundamentals of solar energy by building a small house powered by a solar panel and building a soil sensor to detect the amount of water in the soil of a plant. Start by asking your students: What powers the cars that you see on the street? What about the lights in our school? Have you heard of renewable energy vs. fossil fuels?

⚠️ **The Office of Energy Efficiency and Renewable Energy has some great resources for educators.**

## EXPLORATION ACTIVITIES

🕒 1-2 hrs

### MISSION 1

#### SOLAR HOUSE

In this mission, you will join Piperbot and Pip as they learn about how Zomars store up solar energy before a storm hits. You will simulate the sun with a flashlight and charge the capacitor to light the LED within the house. Ask students: “Have you seen solar panels around your neighborhoods? What challenges do you see with relying on solar energy? What are other sources of clean energy?”

🔗 **Learn more about clean energy [SciToons What is Solar Energy?](#)**

🔧 **Essential Skill:** Understand how Capacitors Store Energy

SOLAR HOUSE BLUEPRINT

MISSION EDUCATOR GUIDE

### MISSION 2

#### SOIL SENSOR

Piperbot and Pip are excited to find sustainable farming operations on Mars! To measure the amount of water making it to the plants, we’re going to build a soil sensor. Ask students: “Have you seen sprinklers in your neighborhood? Are there times that you’re not allowed to water your lawns (i.e., during droughts)? How do you think farmers can use technology like this to have better crops?”

🔧 **Essential Skill:** Moisture as an Input

SOIL SENSOR BLUEPRINT

### MISSION 3

#### AIR GUITAR

You’ve never quite seen an instrument like this! Jam out with an air guitar that uses the same pieces as your soil sensor. Ask students: “What is your code measuring to know when and what sound to play? How is this different from your Ultrasonic Drum?”

## CLOSING

🕒 30 min

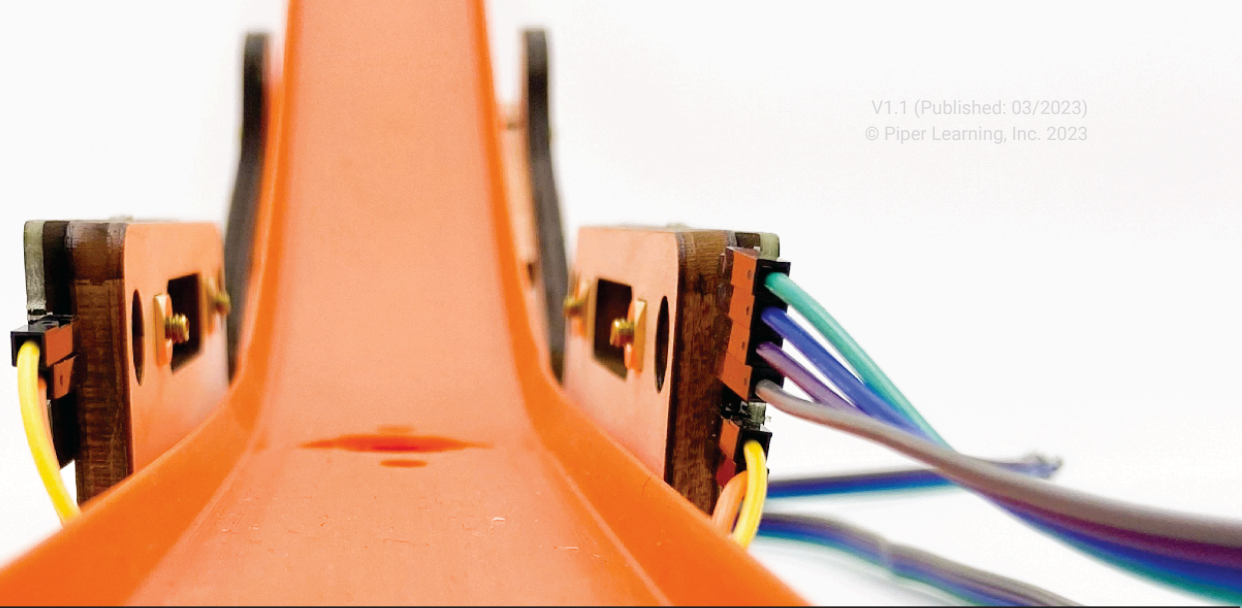
Ask the following questions to guide discussion:

- How did your hardware (Soil Sensor, Solar House) work with the software on Piper Make? What tasks did the system accomplish? **(CA 3-5.CS.2)**
- How can we derive energy from natural resources? What are renewable and non-renewable sources? How do each affect the environment? **(CA 4-ESS3)**

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## VOCAB



### MOTION EXPEDITION

# KINETICS AND MOTION

🕒 1-3 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit, Piper Make Beam Break, Piper Make Motion Ball | 3 Missions

**OBJECTIVES:** Explore how to use technology to measure how objects move in space.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Urban and  
Regional Planner**  
Avg Salary: \$78,500/yr

**Sports Official**  
Avg Salary:  
\$35,860/yr

**Physicist**  
Avg Salary:  
\$152,430/yr

**Avionics  
Technicians**  
Avg Salary: \$69,280/yr

### STANDARDS:

- ★ **CA 3-PS2.A** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. (1.ESS1.A; 4.PS4.A; MS.PS2.A; MS.ESS1.B)
- ★ **CA 4-PS3.B** Ask questions and predict outcomes about the changes in energy that occur when objects collide. (K.PS2.B; 3.PS2.A; MS.PS2.A; MS.PS3.A; MS.PS3.B; MS.PS3.C)

### VOCABULARY:

**Velocity** - Another word for speed, or the rate of change in an object's position

**Acceleration** - Measurement of the change in velocity or how much an object speeds up over time

**Kinetic Energy** - Energy an object has due to its motion; can be converted from potential energy

**Potential Energy** - Energy stored by an object due to its state or position; can be converted to kinetic energy

**Force** - Measurement of a push or pull on an object

**Momentum** - Measurement of mass in motion, equal to the mass times the velocity of an object

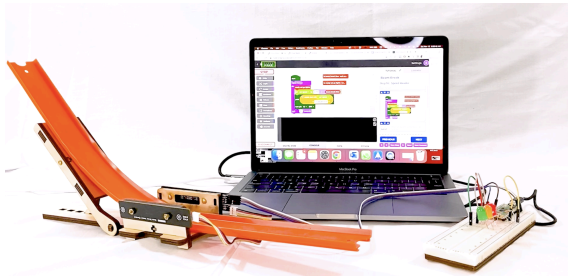
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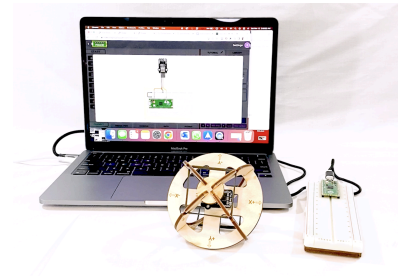
## INTRODUCTION

🕒 30 min

In this playbook, we will be exploring the fundamentals of motion with two widgets:



**Beam Break**



**Motion Ball**

To start, ask your students: What is your favorite sport? If your sport includes a ball (basketball, baseball, soccer, etc.), ask your students to draw how the ball looks. If the sport does not have a ball (swimming, running, etc.), draw a stick figure of how athletes move in the sport.

### TRY IT OUT!

Ask your students: What do you think of when you hear the word “energy”? Many students think of how energetic they feel!

- **Energy Transfer Game:** To illustrate that energy can be transferred, have everyone in the room act like they're tired and create an “energy transfer” where one “energetic” student taps another on the shoulder to transfer their energy! Like a game of telephone, have them pass the energy.
- **Potential vs. Kinetic:** Explain that energy can be stored as potential energy or spent as kinetic energy. Do the following examples and ask your class which has more potential energy:
  - Object a little off the ground vs. high off the ground → CORRECT: High off ground (more distance)
  - Heavy object vs. light object at same height → CORRECT: Heavy object (more mass)Drop each item and see which one falls faster to demonstrate which has more kinetic energy (converted from potential!)
- **Kick a Ball:** Then crumple up a sheet of paper (or find a ball!) and have a student come up and kick it. Right before kicking, tell them to freeze and look at where their foot is. That potential energy gets transferred from their foot to the kinetic energy of the ball.

⚠️ **Note:** The muscles of the legs are also involved in creating some force of the kick.

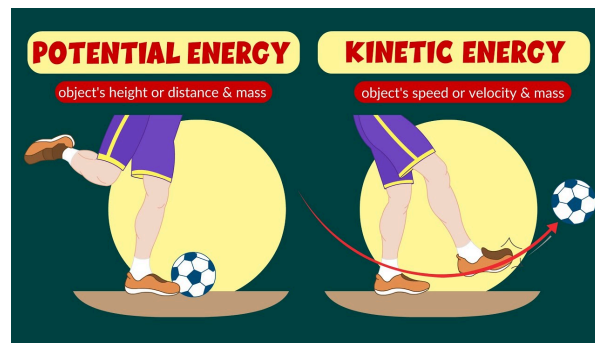


Image credit to [Learning Junction \(YouTube\)](#)


## EXPLORATION ACTIVITIES

🕒 1-2 hrs

### MISSION 1

#### BEAM BREAK

In this mission, you will use an infrared sensor to detect when a Hot Wheels™ car crosses the finish line or “breaks the beam” as it’s traveling down a slope. Using the same LEDs from Traffic Light, drop the car on the green light and see how the slope (and potential energy) affects how fast the car (kinetic energy) rolls down!

 **Essential Skill:** Mathematical Operations In Code

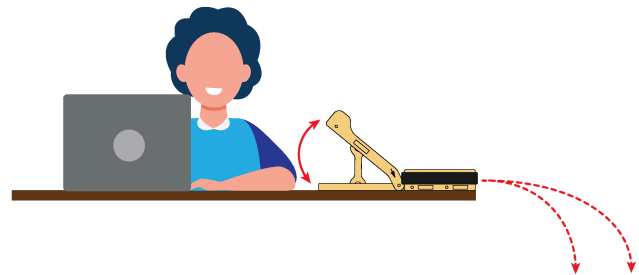
BEAM BREAK V1 BLUEPRINT

BEAM BREAK V2 BLUEPRINT

MISSION EDUCATOR GUIDE

**OPTIONAL:** To even further explore how the slope relates to the potential energy of the car as it travels, have your students place their Beam Breaks on the side of a table and see how far the car flies off the desk!

The higher the slope, the further the car will travel (have someone who measures how far).



### MISSION 2


#### CAR RACE

Let’s go head to head! With V1 of Beam Break, set up two side by side tracks and use the two IR beams to measure which car breaks the beam first. With V2, use the Beam Break mission and compare it to your neighbor’s time. Discuss how you would compare the two times in code to determine a winner.

### MISSION 3

#### MOTION BALL

Piperbot and Pip have stumbled across a Mars Ball field, and Piperbot’s learning about motion in the 3 dimensions. Discuss motion across x, y, and z axes and use the gyroscopic sensor in the ball you build to measure the changes in all three as you play a game of catch.

 **Note:** When passing horizontally, the X-direction should alternate between negative and positive.

 **Essential Skill:** 3D Motion

MOTION BALL BLUEPRINT

MISSION EDUCATOR GUIDE

## CLOSING

🕒 15 min

Ask the following questions to guide discussion:

- How did you measure the car's motion in Beam Break? Did the slope help you predict how quickly the car would go? (CA 3-PS2.A)

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- What happened to the motion ball measurements when you played catch? Which direction measurement changed as you threw it between each other? **(CA 4-PS3.B)**

## CYBERSECURITY MISSIONS

# BASICS OF CYBERSECURITY

🕒 2-3 hours | **WHAT YOU WILL NEED:** Computer, Piper Make Starter Kit, Piper Make Sensor Explorer, Piper Make Light Show | 3 Exploration Challenges

**OBJECTIVES:** Explore cybersecurity basics, like privacy protection and encryption fundamentals.

### CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Information Research  
Scientists**  
Avg Salary: \$131,490

**Education  
Administrators**  
Avg Salary: \$98,420

**Telemarketer**  
Avg. Salary:  
\$28,910

**Security Management  
Specialists**  
Avg Salary: \$74,670

### STANDARDS:

- ★ **CA 3-5.NI.5** Describe physical and digital security measures for protecting personal information.
- ★ **CA 6-8.IC.24** Compare tradeoffs between allowing information to be public and keeping information private and secure.
- ★ **CA 6-8.NI.5** Explain potential security threats and security measures to mitigate threats.

### VOCABULARY:

**Encryption** - Encoding messages to keep them secret, so only the people you want can read it

**Firewall** - Software program or hardware to screen out hackers, viruses, and worms

**Identity theft** – A crime where someone uses personally identifiable data to pretend to be someone else online

**Spyware** – Software that installs itself on a device and secretly monitors activity

**Virus** – Malicious software program loaded onto a user’s computer without the user’s knowledge and does bad stuff

## INTRODUCTION

🕒 30 min

In this playbook, we will be exploring the fundamentals of cybersecurity, or the state of being protected against the criminal or unauthorized use of electronic data, or the measures taken to achieve this. This broad concept is essential for learners who are digital natives in an online world.

Security means different things to everyone. Ask your class: What does being “safe” mean to you? How is physical safety different from online safety? Do your students have parental controls on their internet use?

### STAYING SAFE ONLINE:

Take a few minutes to do some of these entertaining games and teacher resources from the FBI to keep children of all ages safe online. Big questions to ask include: What is a good password? Would you share your name and address with strangers online? Why or why not?

FBI's SAFE ONLINE SURFING

## EXPLORATION ACTIVITIES

🕒 1-2 hrs

### MISSION 1

#### SILLY STORIES (CYBERSECURITY EDITION)

Use these guides below to complete the mission if not already completed, and then proceed to the “Cybersecurity Add-On” below.

⚠️ **This MISSION is also included in the Starter Kit Expedition.**

🔧 **Essential Skill:** Print Statements, Console

MISSION EDUCATOR GUIDE

ASSESSMENT

**CYBERSECURITY ADD-ON:** Use this code (uploaded in Creative Mode, via the switch on the lower right from the home page) to complete a fun, silly story about cybersecurity. Ask students to open the code, hit CONNECT on the lower left, and then START on the top left. After the mission, ask students:

- Who are online attackers? What type of data are online predators looking for?
- How do you know if an email is fake?
- What is the danger if you click on links from fake emails?

SILLY STORY CODE

### MISSION 2

#### COLOR CODED

Help Piperbot and Pip get into the Maker’s City by decoding the color sequence from the Color Wheel. Ask: “How does the Color Sensor interpret color from light that is bouncing back to the sensor? Can it tell between different shades of the same color?”

⚠️ **This MISSION is also included in the Sensors Expedition**

⚠️ **BONUS:** Use the same code to decode the color sequence on Piperbot’s front panel!

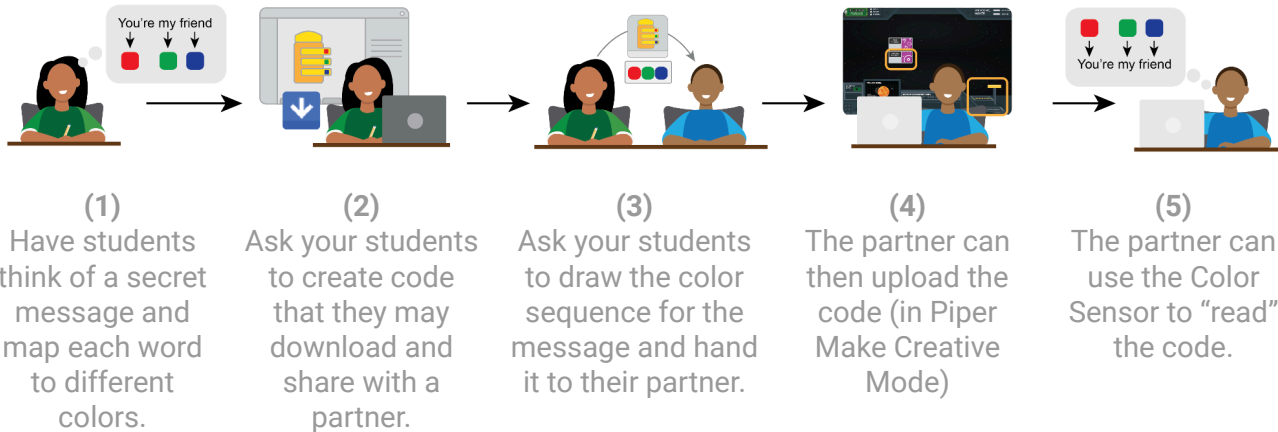
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MISSION EDUCATOR GUIDE

MISSION WORKSHEET

**OPTIONAL:** Curious about how you can use color as a code to send your own messages? Use the following steps to facilitate learning in the classroom:

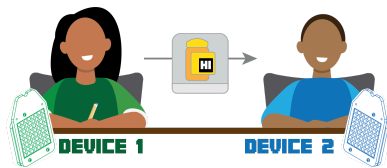


 **This MISSION is also included in the Sensors Expedition.**

MISSION 3

**LIGHT SHOW ANIMATION**

Similar to Color Coded above, ask Student 1 to create a code with their Light Show and then send it via Google Drive to Student 2. Student 2 can use the “Import” feature in Creative Mode to upload the code and “read” it with their own Light Show.



Discuss how this exchange of information is technically **end-to-end encryption** – as the Light Shows serve as encryption and decryption devices while the intermediate (the PNG code) is technically not readable.

 **This MISSION is included in the Design Expedition**

**CLOSING**

 30 min

Ask the following questions to guide discussion:

- What are the security measures you take to protect your personal information online? What type of information? **(CA 3-5.NI.5)**
- Is it nice to know data about your friends (e.g., birthdays, addresses, etc.)? What is the tradeoff of keeping this kind of information private and secure? **(CA 6-8.IC.24)**
- Talk about potential security threats and security measures to mitigate threats **(CA 6-8.NI.5)**



MAKE-A-THON

# INVENT WITH LEARNED SKILLS

🕒 1-2 hours | **WHAT YOU WILL NEED:** An Excited Classroom

**OBJECTIVES:** Reflect on learned skills during your Piper Make build and coding challenges and apply them in our Piper Make-a-Thon to invent technology solutions to the problems you experience in the world around you.

## CAREER CONNECTIONS:

Click each of the careers to learn more about how the skills you will learn can be used.

**Economist**  
Avg. Salary:  
\$106,630

**Pilot**  
Avg. Salary:  
\$202,180

**Database Architect:**  
Avg. Salary: \$123,430

**Physician**  
Avg. Salary:  
\$208,000

## STANDARDS:

- ★ **6-8.AP.13** Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. (P3.2)
- ★ **6-8.CS.2** Design a project that combines hardware and software components to collect and exchange data. (P5.1)

## INTRODUCTION

🕒 10 min

Take apart the Piper Computer Kit using the blueprint to check parts and inventory. Reflect on the build process and what your ideal computer looks like now.

## MAKE-A-THON

🕒 1 hrs

The goal of this event is to get students thinking about using what they have learned about engineering, coding, and design in the context of their own lives and communities. Use the following worksheet to guide this process:

### MAKE-A-THON WORKSHEET

#### STEP 1: IDENTIFYING COMMON PROBLEMS

As a class, brainstorm some problems that your students/community experience. Put some of these ideas on a whiteboard during this open brainstorming session and then select the top options. Good questions to ask to guide this process include:

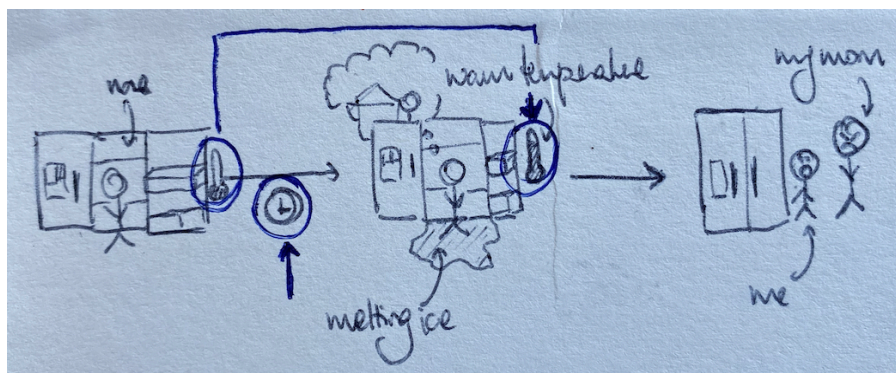
- Can someone tell me the most frustrating part of your morning?
- Do you live in a special climate? Do you get fined if you use your sprinklers at any point?

#### STEP 2: FORMING GROUPS

Ask students to select the problem that they want to tackle and ask them to split into groups. Rearrange groups as necessary to facilitate diverse perspectives in each group.

#### STEP 3: INVENTING SOLUTIONS

Ask students to break down the problem first, into the steps that make it a problem. See the following example from a real student on a common problem she was facing! **Ask students to identify where an invention could intervene.**



#### STEP 1

"I went to the fridge this morning to get a snack, and I opened it"

#### STEP 2

"I got distracted and stood there staring and ice started melting and the fridge warmed"

#### STEP 3

"I get yelled at by my mom because food got ruined"

Think about what changes happened between Step 1 and 2. This class discussed measuring:

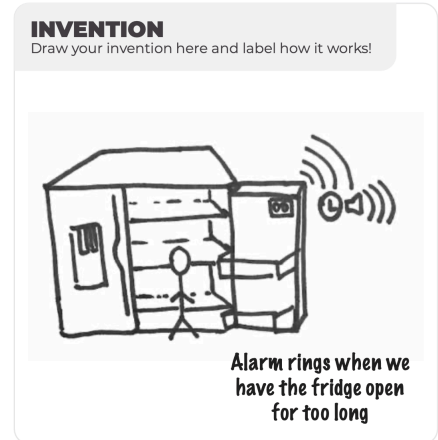
- TEMPERATURE going up
- The amount of TIME the door is open

This group decided that they wanted to measure the **TIME** the door is open and set an alarm when the door was open for too long:

#### STEP 4: DETAILING THE CREATION

Ask students to draw out what the invention would look like. What pieces of technology would it use? What elements of coding would be helpful?

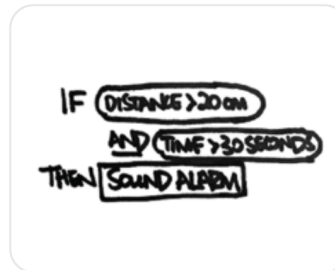
For this group, we asked – “How would you measure the fridge door being open? What piece of technology did we use before to measure distance? What would you like the **CONDITIONS** to be to trigger the alarm?”



What hardware does your invention use? (Draw it!)



What elements of code would your invention use?



#### STEP 5: TELL US ABOUT YOUR BRILLIANT CREATIONS

Send us your best creation at [hi@playpiper.com](mailto:hi@playpiper.com) to be featured in our next newsletter!

### CLOSING

🕒 30 min

Ask the following questions to guide discussion:

- What was the most difficult part of decomposing the problem that your group chose? What was the subproblem that you were able to design your solution for? (6-8.AP.13)
- Do you feel confident about the hardware and software components you designed? Do you think they can gather the data and respond to the challenge? (6-8.CS.2)

Use the Piper Post-Survey and compare it to pre-surveys (matched by name from before) to understand how your Piper Computer Kit experience affected key learning outcomes.

**PIPER POST-SURVEY**

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Email us at [hi@playpiper.com](mailto:hi@playpiper.com) with any questions/concerns/recommendations.  
Thank you for joining us inspiring the next generation of inventors!