PIPER MAKE

## YOUR GUIDE TO GETTING STARTED

WELCOME,
MAKER

Welcome to the wonderful world of Piper Make, where you'll explore the fundamentals of building hardware and coding technology, all from your own computer! Just head on over to **make.playpiper.com** on your browser, and join our duo of unlikely friends—the first sentient robot in space, Piperbot, as he teams up with the witty Martian mouse, Pip—to explore new frontiers on Mars together. As you go, you'll complete different missions in Piper Make, building technology right in front of you and coding it using drag-and-drop code in your browser.

But Piperbot and Pip are going to need more than just the missions you'll see on Piper Make StoryMode (especially since someone seems to be messing with Piperbot's ship…). So as you explore and learn the basics, check out our Maker Challenges and head over to CreativeMode to create your own cool gadgets. Psst, if you create something especially cool, grab an adult and share it with us using the handle **@startwithpiper** or email us a picture at **hi@playpiper.com**!

Ready for your first mission? Let's get started. Welcome to Piper Make—what will YOU create?

Signing off,
The Piper Team

2
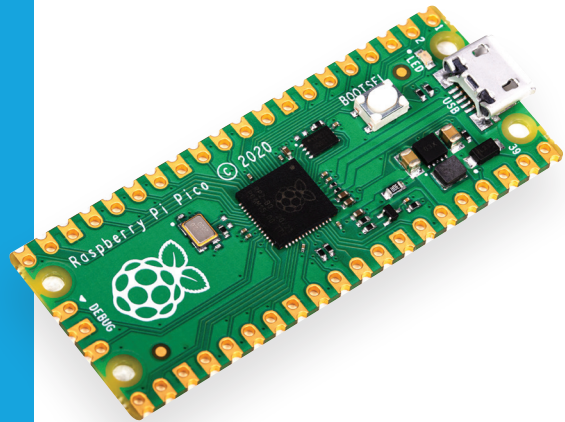
THIS IS YOUR STARTER KIT

Your Piper Make Starter Kit contains a variety of electronic components, a breadboard to slot them into, and jumper wires to connect them and create circuits. The key to making everything work, however, is the Raspberry Pi Pico.

The size of a stick of gum, the Pico is a powerful new microcontroller board that you will use to control the circuits for your projects. You can think of it as the brains of the operation.

You can connect electronic components to the Pico's input and output pins so that it can control them. Pico also has a micro-USB port that is used to connect it to a computer in order to program it and tell it what to do.

A GUIDED TOUR
OF THE PICO

**Let's take a tour of the Raspberry Pi Pico microcontroller board and its key features...**

GPIO PINS

Arranged along either long side of the Pico board are 40 pins. These provide the board with connections to the outside world—known as input/output (I/O). Most of the them are GPIO (general-purpose input/output) pins that can be used to sense inputs (such as the press of a button), and control outputs (such as an LED). Others have special functions such as supplying power, acting as a ground connection, or enabling analog (in addition to digital) input from sensors.

MICRO-USB PORT

At the top of your Pico is a micro-USB port. This provides power to your Pico, and also lets it talk to your computer via its USB port—which is how you'll load your programs onto your Pico.
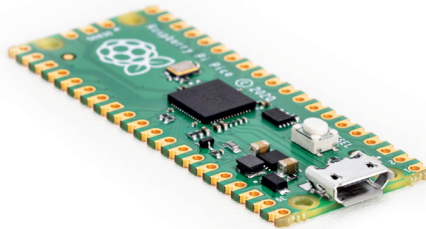
BOOTSEL BUTTON

Just below the micro-USB port is a small button marked 'BOOTSEL' (short for 'boot selection'). When this is held down as you connect your Pico to a computer, it switches the Pico to a special mode so you can install MicroPython firmware that will enable you to run programs. You should only need to do this once.
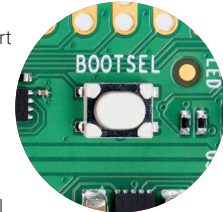
RP2040 PROCESSOR

This is the microcontroller chip that powers your Pico. If you hold it up to the light, you'll see a Raspberry Pi logo etched into the top of the chip.
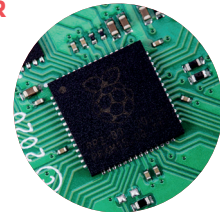
PROGRAMMING
WITH MICROPYTHON

To get our Pico do different things, we'll need to write programs. Those are written in different programming languages—like C and CircuitPython. We'll be using one called MicroPython.

MicroPython is a Python-compatible programming language developed specifically for microcontrollers such as the Raspberry Pi Pico. It includes many of the features of mainstream Python, while adding a range of new ones designed to take advantage of the facilities available on the Pico and other microcontroller boards.

If you've programmed with Python before, you'll find MicroPython immediately familiar. If not, don't worry: it's a friendly language to learn!

BLOCK-BASED CODING
While you would normally write MicroPython programs in a text editor or IDE (integrated development environment), Piper Make offers an even simpler method.

You may well be familiar with block-based programming from other applications like Scratch. The Piper Make website (**make.playpiper.com**) offers a similar visual interface, enabling you to drag and drop code blocks to create your MicroPython programs. You can even see a text version of the code you've created in the Python tab of the online editing interface.

Once your program has been created, you can press the Start button in the editor to run it on the Pico. If you've done everything right, it should work as intended; if not, don't worry—play around with the code and try again.

See the opposite page to find out more about how to use the Piper Make online editor to start creating your own programs.
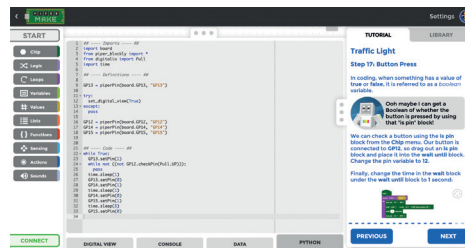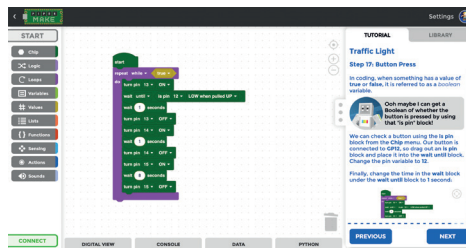
THE PIPER MAKE
USER INTERFACE

The Piper Make interface at **make.playpiper.com** enables you to program your Pico by dragging and dropping code blocks. Once you have installed the firmware on your Pico (by clicking the 'Setup my Pico' tool at the bottom of the main projects page), you are ready to start coding—in a blank New Project or one of the existing Maker Challenges with built-in tutorials.

1 BLOCK CATEGORIES
Code blocks are arranged into helpful color-coded categories. Click on one to reveal its collection of blocks.

2 CODE AREA
Drag blocks into the central area to add to your program. You can drop a block under or into another one to connect it.

3 START BUTTON
Click the Start button to run your program on the connected Pico.

4 CONNECT BUTTON
Click this button to connect the user interface to the Pico plugged into your computer.

5 DIGITAL VISUALIZER ELEMENTS
Click one of the tabs here to reveal one of four visualizers. **Digital View** lets you see if your running program, when you hit Start, is sending signals to particular pins. **Console** displays what the program is doing in real-time. **Data** lets you view the data being sent from various inputs. **Python** shows a text version of the MicroPython program you've created.

6 TUTORIAL / LIBRARY
If you are doing one of the Maker Challenges, this is where you'll see instructions for what to do. The Library tab gives info on components.
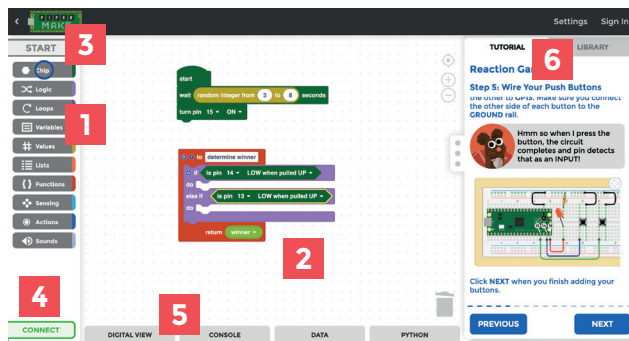
EDUCATION AND CAREERS

Are you an educator who wants to use Piper Make in the classroom? If so, it has some very useful Google Classroom integrations that enable you to use a single sign-on (SSO), share projects with a class, and save code block images to Google Drive.

Google SSO: From the **make.playpiper.com** homepage, click 'Sign In' at the top right and sign in with your Google Classroom educator account, then click on Allow for all the permissions required by Piper.
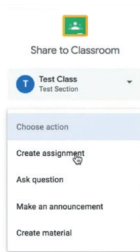
Share a project: To share a Maker Challenge project with a class, click the classroom icon at the top right of its icon on the homepage. Choose a class from the first drop-down, then select 'Create assignment' from the second drop-down. Click on Go, add any instructions you like, then click Assign to post it to the class.

Save your code: To save a PNG image file of your code blocks for a project, click the down arrow icon next to its icon on the homepage. You then have the option of downloading the file or adding it to your Google Drive.

CAREER CONNECTIONS

Creating projects with Piper Make is a lot of fun, obviously, but the skills you'll learn should prove useful for your future career. Demand for coding skills is at an all-time high in a wide range of fields. Let's take a look at just a handful of the many possibilities…

Computer programmer: The most obvious career choice for a master coder is to become a programmer. The MicroPython language used in Piper Make is a subset of Python, one of the most popular programming languages in the world, so you'll already have a head start.

Web developer: Websites are built using code, so honing your coding skills will give you an advantage when it comes to creating them using languages such as HTML, CSS, and JavaScript. A web developer is responsible for building the more advanced functionality of a website.

Scientist: Coding is a key skill in the STEM (Science, Technology, Engineering, and Mathematics) curriculum. Along with scientific knowledge, a scientist may need to create computer models to help analyze their research data. Coding also involves problem-solving skills.

Product manager: If you are a product manager for a company, coding skills will help you to understand technology limitations. This will enable you to set realistic deadlines for projects and to communicate better with engineering and design teams.

CREATIVE MODE

As well as completing the Maker Challenge project tutorials in the Piper Make online editor at **make.playpiper.com**, you can create your own custom projects. Just click on the New Project icon at the top of the homepage and you will open a blank new project. It will be given a random name, like Chloe or Bruno, but you can change this in the editor.

With your new project open, the online user interface looks very similar to that in the Maker Challenge tutorial projects. Instead of tutorial instructions, however, the right panel features a Save tab where you can change the project name at the top and add a description for it.

In addition, you can hit the Download button to save a PNG image of your code blocks to your Google Drive. Note that you will need to be signed in with your Google account for this to work. It will be saved in a folder called My Piper Make Projects.

MAKER'S CHALLENGES
Within this booklet, we've come up with a few special Maker's Challenge ideas for you to try. Well, this is the place to do it, in a blank new project. Or you could just get creative with your own ideas, of course, and make whatever you like!

A new project is a blank canvas for you to complete our Maker's Challenges or create whatever you want

GETTING STARTED

On Earth, the Commander and his team have built Piperbot, but can they get him to move? It'll require the completion of a simple circuit.

Mars Robot Development

ON EARTH...

AND BEHOLD: A MARVEL OF MODERN TECHNOLOGY, PIPERBOT!

CLAP CLAP CLAP CLAP CLAP CLAP

WELL, THAT'LL BE A FIRST: TO GET A ROBOT ON MARS!

IT TOOK US YEARS, BUT WE'RE SENDING HIM OFF TO EXPLORE THE UNIVERSE.

NOW, PIPERBOT IS BASED ON THE SIMPLE CIRCUITS WE ALL LEARNED ABOUT WHEN WE WERE YOUNG, TO MAKE HIM MOVE...

PIPERBOT FAILS TO MOVE.

OOH, MAYBE WE GOTTA FIX SOME BASICS FIRST?

MISSION:
Using two
wires and a
push-button
to form a
simple circuit.

BLINK AND TRAFFIC LIGHT

Can you help Pip set up a blinking light to help Piperbot find the landing site on Mars? Once you've done that, can you help Piperbot make a traffic light system to direct the local spaceship traffic?
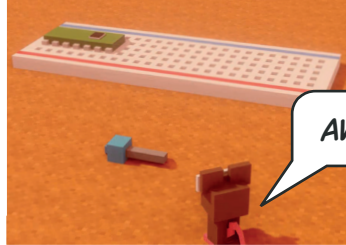
On Mars, Pip sees a spaceship arriving.

On the ship...

Aw, it's Mars. Where do I land?

Oh no, he really doesn't know where to land!...

...If only there was a way I could show him that we have this old landing pad here.

AW!

SHOOT! That's not enough? What else do I need to do?

MAKER'S CHALLENGE:
BLINK TO THE BEAT

Pip is planning a welcome party for Piperbot and would like some help with the light show for the disco. Can you help Pip create a light that flashes in time to some music? It could be for your favorite song.

HINT

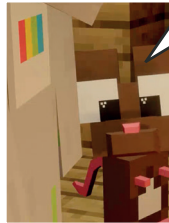Altering the wait times in your program might help.

REACTION GAME

As Pip and Piperbot settle down beside the fireplace for the evening, Pip boasts that he has the fastest reactions on the planet. Piperbot disagrees. Time to find out for sure with a reaction game...

IN PIP'S HUT...

AW, ISN'T THIS THE COZIEST CHILLY MARS EVENING?

ENJOY IT WHILE IT LASTS. WEATHER CHANGES IN THE BLINK OF AN EYE HERE ON MARS.

OH, IT CAN'T BE *THAT* QUICK.

WHEN THE WEATHER ALERTS *GO OFF*, IT'S A RACE TO BOARD UP THE HUT. I HAVE THE FASTEST REFLEXES ON ALL OF MARS!

YOU? OH COME ON! I BET I CAN TAKE YOU.

OH, YOU'RE SO ON! LET'S GO...

MAKER'S CHALLENGE:
BEST OF THREE

Piperbot says he wasn't quite ready to play and wants to make it the best of three. Can you change your program to add a point for each of three rounds and then declare a winner?

HINT
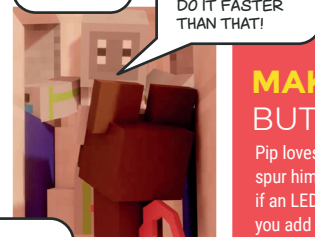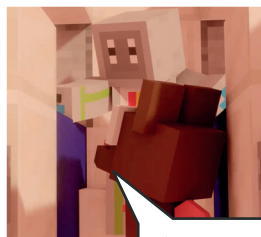You'll need to use a variable for each player to log how many points they've won.

TALLY

Oh no! The ignition in Piperbot's spaceship isn't working! Can Pip turn the key more times in ten seconds to kick the ship into gear? You'll need to find a way to count the button presses…

AW PIP, WE'VE HAD A GOOD TIME, BUT I THINK IT'S MY TIME TO HEAD HOME.

BACK AT THE LANDING PAD…

AW, I'LL MISS YOU BUDDY, BUT I'M SURE I'LL SEE YOU AGAIN.

PIPERBOT WALKS BACK TO THE SHIP.

HE TURNS THE IGNITION KEY.

OH, THAT'S NOT GOOD!

MAYBE JUST DO IT REALLY QUICK A FEW MORE TIMES?

Whirrr-rrr-rrr… SPUTTER!

PIPERBOT TRIES AGAIN.

YOU SO CAN **NOT** DO IT FASTER THAN THAT!

HERE, I CAN DO IT FASTER. LET ME TRY!

MAKER'S CHALLENGE:
BUTTON FLASH

Pip loves a light show and thinks it might spur him on to press the button even faster if an LED flashed each time he did it. Can you add an LED to your circuit and make it flash every time the button is pressed?

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GUESS **MY NUMBER**

Help Piperbot and Pip get into the on-board safe with tools to repair the spaceship! If only they knew the code…

On the ship…

There are some tools locked away in this safe…

Beep!

...but I can't seem to remember the code.

There's gotta be a better way than just guessing. If only we know if you were too high or too low.

MAKER'S CHALLENGE:
BEST OF THREE

Pip wonders whether, instead of inputting guesses manually in the Console, we can change the code to get it to guess for us?

TEST
QUESTION

What's the quickest way to find a random number in a lower-higher guessing game?

Answer: Make a mid-range first guess, then keep doing the same for the new reduced range when you know whether it's higher or lower. Each time, you're narrowing it down.

SPEAK LIKE A MACHINE

Can you help Piperbot and Pip understand what Binator is saying? Perhaps it has something to do with converting binary numbers?

Exploring Mars...

I think it's somewhere around here...

And you're positive there was a crash landing here 20 years ago?

Yeah, it was the first Mars rover and relied on some old code.

Hey! Watch your step!

Down below, another robot is lurking.

Hi there, you must be Binator! I'm Piperbot.

Um... me Pip! You help... us... ship?

So I'm stranded and my ship broke and I was wondering if you had some tools?

0-0-0-1-1!

SPEAK LIKE A MACHINE cont...

0-0-0-1-1!

Aw, this was a bust!

0-0-0-1-1!

Wait! Any chance he's saying the password in that old code you mentioned?

Huh? Maybe.

BOUNCY NUMBERS

+1

×3

Odd

Even

÷2

Can you help prove whether the Collatz Conjecture is true or not? You need to pick any positive number. If the number is even, you divide it by two. If the number is odd, you multiply it by 3 and then add 1. You keep doing this and, eventually, it should end up as the number 1.

MAKER'S CHALLENGE:
DECIMAL TO BINARY

Pip and Piperbot would like to say thanks to Binator. Can you alter your program so that it converts decimal numbers into binary?

HINT
You'll need to alter the numbers in your 'create list' block.
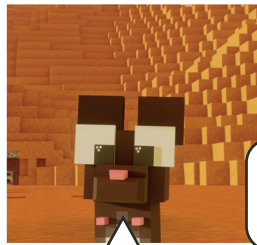
WHO IS THE **MASTER MAKER?**

Piperbot keeps hearing about a 'Master Maker' who lives on Mars, but who is he and what is his interest in Pip and Piperbot?

Near a Martian Pyramid...

THE MASTER MAKER IS CALLING YOUR SHIP A PIECE OF JUNK!

OK, WHO IS THIS MASTER MAKER? AND HOW DOES HE KNOW ABOUT MY SHIP NOT WORKING?
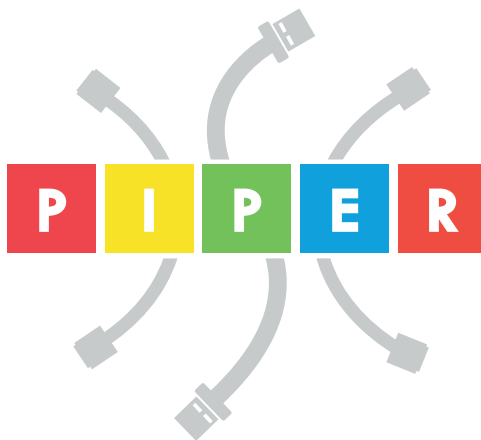
IT IS A BIT WEIRD THAT THE MASTER MAKER IS KEEPING TRACK OF US...

WAIT, HE'S FROM EARTH TOO? MAYBE HE CAN HELP ME GET BACK...

LEGEND HAS IT THAT HE WAS THE FIRST VISITOR FROM EARTH.

HE CREATED THIS HUGE CITY ON THE OTHER SIDE OF MARS AND BARELY ANYONE HAS EVER SEEN IT!

STAY TUNED FOR MORE NEW PIPER MAKE WIDGETS TO JOIN PIPERBOT AND PIP ON THEIR ADVENTURES!

PIPER

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