



HOW OLD ARE YOU ON MARS?



SCIENCE AND TECHNOLOGY

MISSION DESCRIPTION

As you probably know, a year is the period of time that Earth takes to complete an orbit around the Sun. Our nearest planetary neighbour, Mars, has a larger orbit around the Sun than Earth does. This difference in orbits is why a Martian year is much longer than an Earth year. In fact, in Martian years you're about half as old as you are in Earth years!

Scientists and engineers (among others) often use computers to process data or perform complicated or repetitive calculations for them. To do this, they are sometimes required to write code to describe the calculation they would like performed. In this challenge, you will create a small program that takes your age in Earth years and outputs your age in Martian years. You will use **JavaScript**, a programming language used everywhere online. It's accessible if you have a Web browser and easy to understand.

You will start by doing the calculation by hand, so that you understand the math behind the conversion, and to give you an appreciation of the benefits of coding.

Difficulty: **MODERATE**

Duration: **50 MINUTES**

Material: **MINIMAL**

GOAL

Participants will learn about simple coding.

OBJECTIVES

By the end of this mission, participants will

- Understand the difference in planetary cycles
- Understand how to do a simple code using JavaScript
- Understand how this type of coding can simplify large amounts of work

MISSION PREPARATION

TIMELINE

Description	Duration
Background	5 minutes
Instructions	15 minutes
Group activity	25 minutes
Wrap-up	5 minutes
Total	50 minutes

MATERIAL

- Paper and pencil
- Calculator
- Computer with a Web browser (e.g. Google Chrome, Microsoft Edge, Mozilla Firefox)



BACKGROUND

Digital technologies have changed how people learn, work and live. Digital literacy is a critical skill and continues to become increasingly important for the future. Deep-space missions are relying more and more on artificial intelligence (AI) and programming to create autonomous robots that can make decisions on their own. Canada is building Canadarm3 for the Lunar Gateway, a small space station that will orbit the Moon. Canadarm3 will require programming that was not necessary in the previous Canadarms in order to complete tasks on a daily basis almost 400 000 km from Earth. Future missions to Mars will require even more autonomy and sophisticated programming. Coding is one way to use imagination and innovation to create something new. This introductory coding activity shows participants just how easy it can be to start on the path to becoming digitally savvy.

TERMINOLOGY

- **Statement:** most of what you will code in JavaScript will be made of statements. Below, you will see many semicolons (;). These denote the end of a statement. In most programming languages, semicolons are required, but they are optional in JavaScript. Still, it's good practice to use them.
- **Variable:** a variable stores a piece of information, called a value. In JavaScript, variables are created using the `var` keyword. To assign a value to a variable, use the following syntax:

```
var pays = 'canada';
```

- The variable `country` now holds the value `canada`.
- In the following exercise, `earthAgeYears`, `earthAgeDays`, `marsAgeDays` and `marsAgeYears` are all variables that store numbers.
- Because variable names cannot have spaces, we separate different words by making each one start with a capital letter. Note that variables conventionally start with a lowercase letter.
- **Mathematical operations:** are represented similarly to how they are written by hand. “Plus” is `+`, “minus” is `-`, “multiply” is `*`, and “divide” is `/`.
- **Console:** an interface for real-time programming. The console we use lives in your Web browser. After you type in some code, hit the Enter key and your code will immediately be run. Its results will also be displayed.

ACTIVITY WORKSHEET

BY HAND

Following standard scientific procedure, round numbers only at the end.

1. Multiply your age in Earth years by 365.25 to get your age in Earth days. There are technically 365.25 days in a year; that is why every four years, there is a *leap year* with one extra day.
2. Divide that number by 1.027 to get your age in Martian days. You must divide since a Martian day has the length of about 1.027 Earth days; in other words, a Martian day is a longer unit of time than an Earth day.
3. There are about 668.599 Martian days in a Martian year, so divide your number by that to get your age in Martian years.
4. Round this number down to the nearest whole number to get your Martian age as you would tell it to someone else.

Here is an example for someone who is aged 15 (in Earth years):

Earth years are represented by E_{years} Earth days are represented by E_{days}

Martian years are represented by M_{years} Martian days are represented by M_{days}

$$15 T_{years} \times \frac{365.25 E_{days}}{1 T_{year}} = 5478.75 E_{days}$$

$$5478.75 E_{days} \times \frac{1 M_{day}}{1.027 T_{days}} = 5334.712755598832 M_{days}$$

$$5334.712755598832 M_{days} \times \frac{1 M_{year}}{668.599 M_{days}} = 7.978942169519894 M_{years} \approx 7 M_{years}$$

We round this number down to 7 because, even though you are very close to being 8 years old, you would still say you are 7.

PROGRAMMING

Now, repeat the calculation you did above—only this time, using JavaScript.

1. Open your favourite Web browser and hit the F12 key. There should be a clickable tab called “Console” at the top of the window that just appeared. (If this doesn’t work, search “Open developer tools Chrome/Firefox/your browser” and follow along from there.)
2. In the **console**, type your first **statement**. Create a **variable** that stores your age in Earth years by typing the following code and hitting the Enter key. The example below is for someone who is 15; replace `15` with your own age.

```
var earthAgeInYears = 15;
```

3. Convert your age to Earth days by typing the following code and hitting the Enter key.

```
var earthAgeInDays = earthAgeInYears * 365.25;
```

4. Convert your age to Martian days.

```
var marsAgeInDays = earthAgeInDays / 1.027;
```

- Convert your age to Martian years and remove the numbers after the decimal point. `Math.trunc()` simply removes the digits after the decimal point in the number.

```
var marsAgeInYears = Math.trunc(marsAgeInDays / 668.599);
```

- Finally, print your age in the console. `console.log()` prints messages to the console. The message in orange should appear.

```
console.log('Your age on Mars is about ' + marsAgeInYears + ' years old.');
```

```
Your age on Mars is about 7 years old.
```

ADVANCED VERSION

Copy the following code and paste it all at once in the console, then hit Enter. What happens? Afterwards, try to understand what's going on in each line. Make sure to type a positive number (and not a negative number or a word) into the popup text box. What happens if you don't? How is this accounted for in the code?

```
var earthAgeInYears = -1;
while(!(earthAgeInYears > 0)) {
    var input = prompt('Please enter your age. You must enter a number greater than 0. ');
    earthAgeInYears = parseInt(input);
}
var earthAgeInDays = earthAgeInYears * 365.25;
var marsAgeInDays = earthAgeInDays / 1.027;
var marsAgeInYears = Math.trunc(marsAgeInDays / 668.599);
console.log('Your age on Mars is about ' + marsAgeInYears + ' years old.');
```

- The `while` keyword loops through the following code as long as the condition is true. Here, as long as what's inputted in the text box is not a positive number, it will keep asking for your age.
- `prompt()` creates a popup dialog that accepts an input.
- `parseInt(input)` converts `input` from a word into a number, from JavaScript's viewpoint. It just so happens that anything entered into `prompt()` in line 1 will be interpreted as a word, even numbers like "15," so this is a necessary step in order to do calculations with `input`.

CONCLUSION

Coding is a useful tool that, among other things, simplifies complex or repetitive calculations for scientists and engineers.

In this exercise, you wrote a small program to convert your Earth age to your Martian age. It may have been slower than doing it by hand—but imagine you had to convert the ages of everyone at your school. Doing all that by hand would take a long time! The JavaScript program reuses the same calculation logic for any input, so you will only have to go through the writing process once. You can then instantly convert any amount of ages afterwards.