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A NEW ADVENTURE FROM ‘ROBOTS FOR STEM’

STEMIE & STEMIA’S FANTASTIC JOURNEY THROUGH SPACE

STUDENT’S eBOOK

Co-funded by the Erasmus+ Programme of the European Union

Stemie & Stemia‘s

fantastic journey through space

Student‘s eBook

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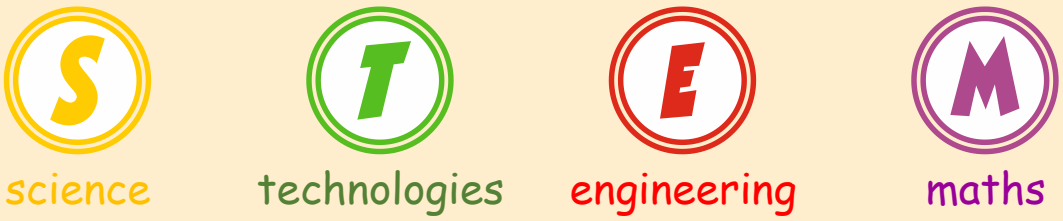
MAKE IT PEDAGOGICAL

Searchlighter

Conventional signs

Throughout this book, you will find some conventional signs and symbols that represent various features or subjects.

Whenever you find one or several of the following signs:



you know that a specific exercise is related to that specific subject.

NOTES on each chapter will be marked with this frame.

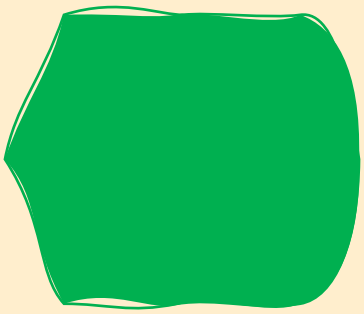
If there is additional **INFO**, you will see it inside this frame.

The **GOAL** of each challenge will be written in this format.

Whenever you have a part of the **STORY** to read, it will be signaled with this frame.

There is something to **DISCUSS** with your classmates. This will be the sign.

You finished first the proposed tasks and have nothing else to do? There are some **EXTRA TASKS** waiting.



Also, while reading code written in **mBlock**, there are some basics that you need to remember:

Hat blocks are used to start scripts and are always placed on the top of other blocks.

A Stack block is a rectangular block with slots on the top and bottom that allow to fit above or below other blocks.

A **reporter block** allows you to store data and contains a value that can be a numerical value or character string.

A **boolean block** contains a condition that can be either "true" or "false" and is typically used inside condition blocks like IF.

A **Cap block** is used to a script or project and therefore it can be put only under all blocks. Don't forget that in your project you should have only one forever block.

Notice that there are no slots in the bottom of the block.

Connectors, constants, startup sound **Procedures**. These blocks must **ALWAYS** be the first in your code.

Blocks that Turn on motors. In this example, Forward (motor 1, right side) and backwards (motor 2, left side).

Time that a certain action takes. For example, the time that the motors are turned on or off.

Stop both motors.

Other things that are useful to know:

Your robot doesn't have any loose wires. If you have one, it should be disconnected from somewhere;

The colour of the wires doesn't matter. Just the type and length so that they connect to where they are supposed to;

Vcc is always connected to the positive (+) pole of current while GND is connected to the negative (-) pole.

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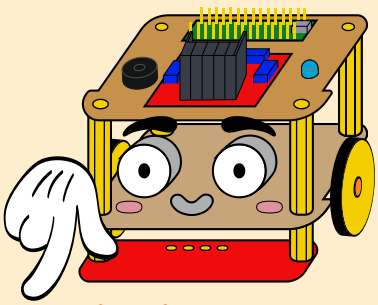


Challenge 6
Flashing lights

Page 46

Already on the Moon, Stemie and Stemia need to turn on their lights to be seen by each other

Challenge 7
Sequences and Loops

Page 51

Mars is the next destination. Help our friends by teaching them how to create command sequences and loops and ride around the Olympus Mons

Challenge 8
Organizing thoughts

Page 58

While Stemie and Stemia are enjoying themselves on Mars, At is repairing the spacecraft engines. By doing so he is Teaching Stemie and Stemia about Procedures

Challenge 9
Following trajectories

Page 65

Help Stemie and Stemia to follow an unexpected track they found on the Mariner Valley

Challenge 10
Avoiding obstacles

Page 72

Almost 100% functional, Stemie and Stemia need to learn how to detect objects and measure distances to escape the asteroid ring

It all started when...

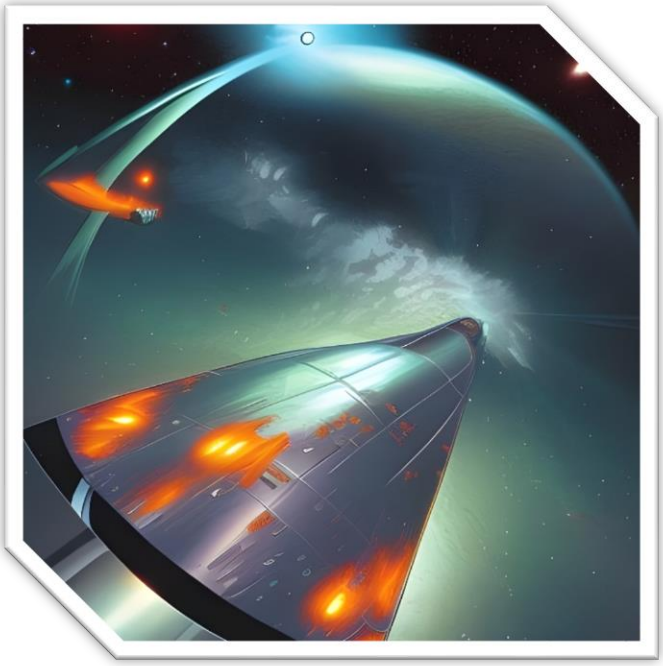
Stemie and ***Stemia***, along with their assistant ***At***, decided to travel to our solar system.

They are very curious robots. That's why they were trying to gather as much information as possible about our solar system's planets and star.

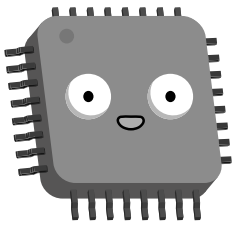
Their plan was to stop on every planet and asteroid and visit everything there. After all, it was their first time in our solar system.

The journey was going very well until, somewhere between the orbits of the planets Jupiter and Mars, their spaceship suffered from gravitational perturbations and was hit in the asteroid belt.

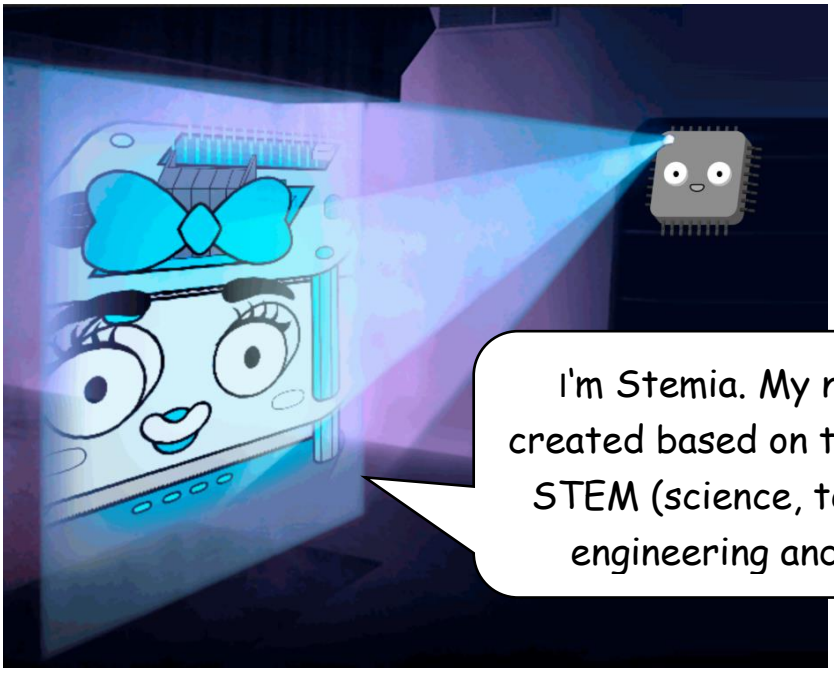
While suffering with their injuries, **Stemie** and **Stemia** managed to reach Earth, the only planet where they could gain the help that they needed – they were completely torn apart.

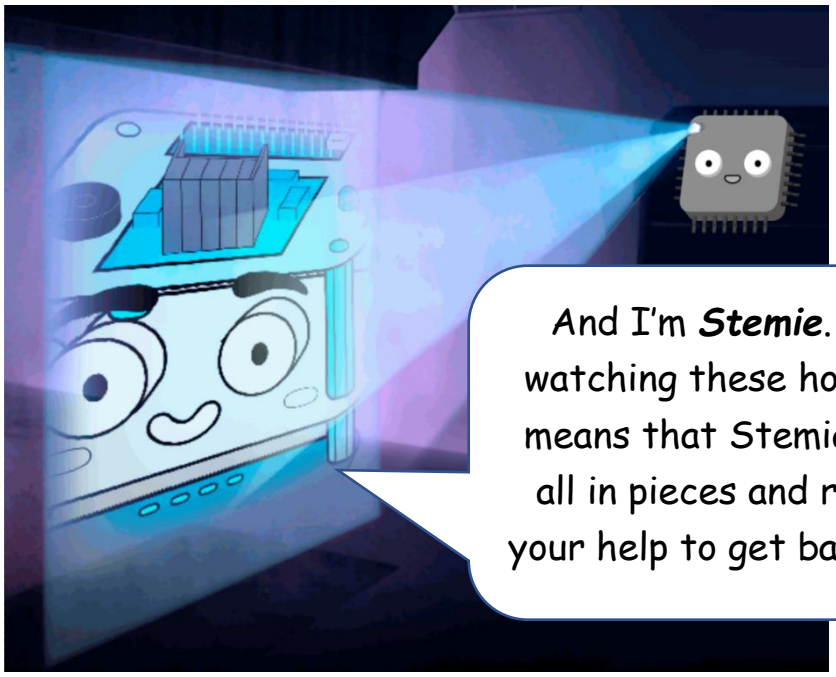


Only ***At*** managed to get in one piece and is trying to find a master robot assembler to help.



Hi! My name is ***At***. It's a nickname that comes from the ATmega328 processor. that Stemie and Stemia are equipped with. I am your assistant in this book.





Can you do it? We are sure you will like them.
When fully assembled, they can do amazing things.

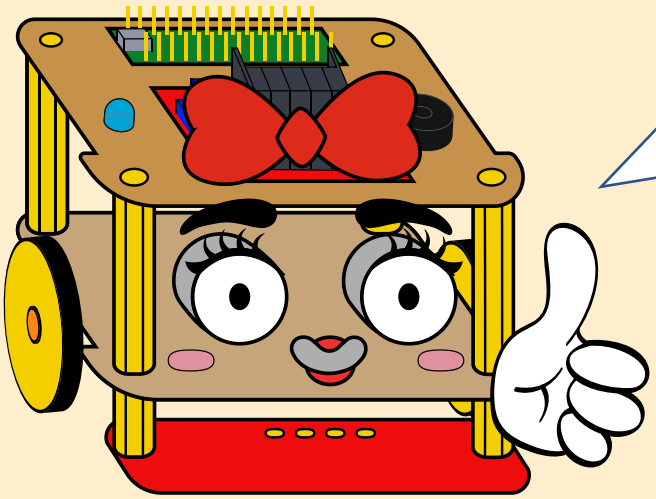
CHALLENGE 0 Gathering the parts

GOALS: I can assemble the robot and by using the checkup program, examine if the robot works.

1. Help Stemie and Stemia get back together. **Assemble the robot**. You complete the challenge if the checkup program does exactly what it is supposed to do.

The instructions of assembling the robot are HERE or scan the QR code.

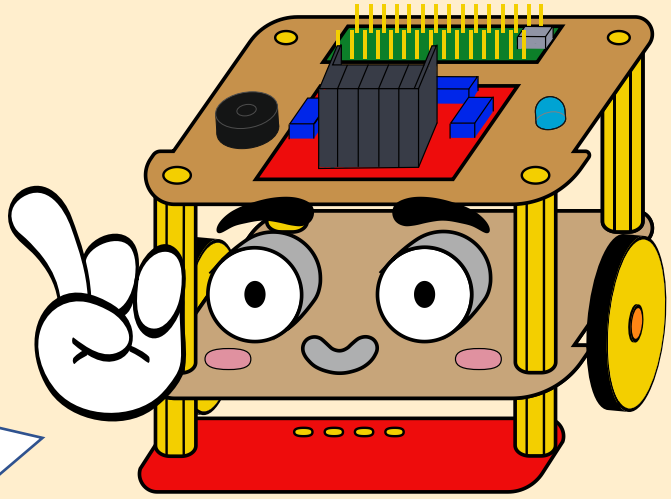
I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Assemble the robot			
Examine the robot using the checkup program			
Where can these ideas be applied in a real word?			



Ah! It feels so good to be back.

You did a great job.

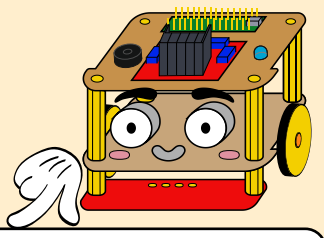
Thank you!



But we still need your help. All our settings are wrong, and need to be corrected.

I think you are the right person to do it.

CHALLENGE 1 Learning to drive



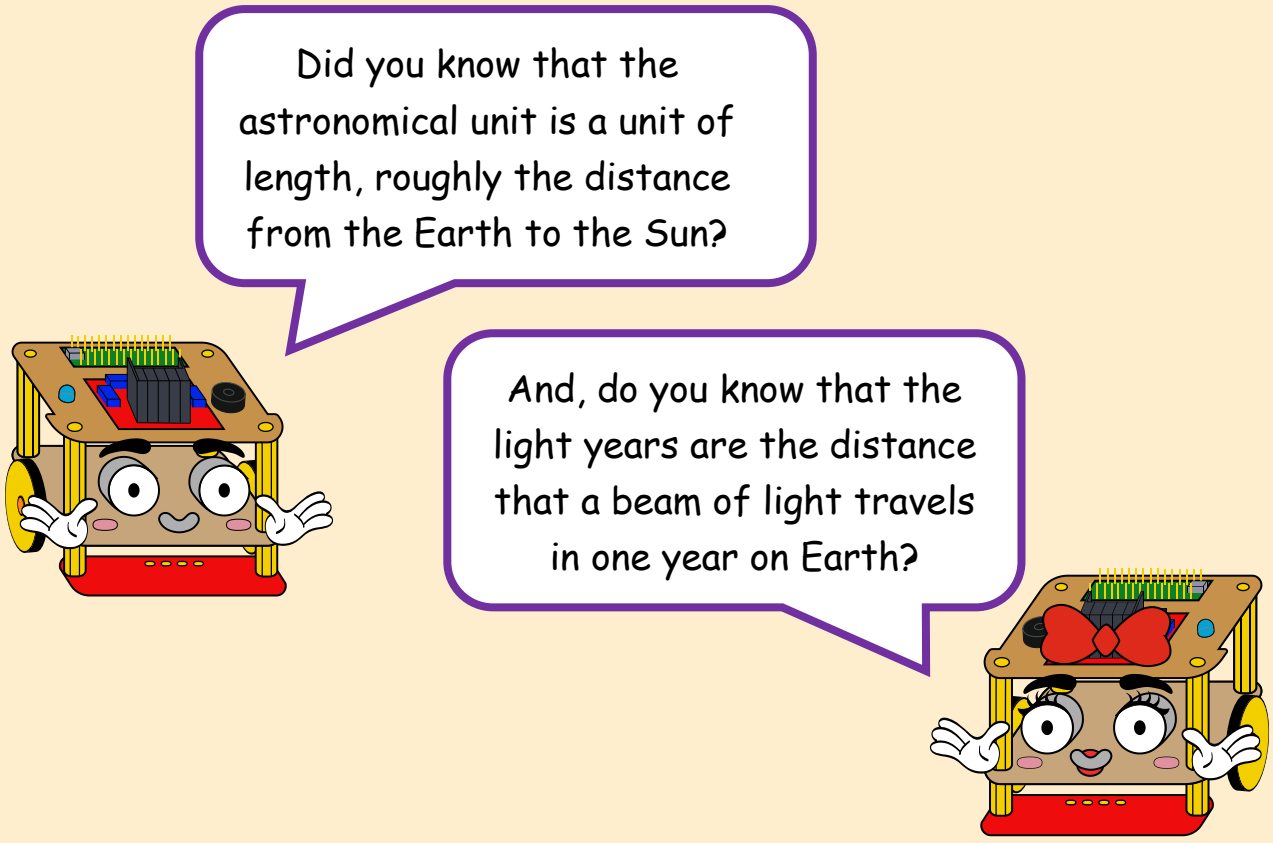
Please charge my batteries regularly so I can work at my best.

GOALS: I can name different measurements and program the robot to go straight.

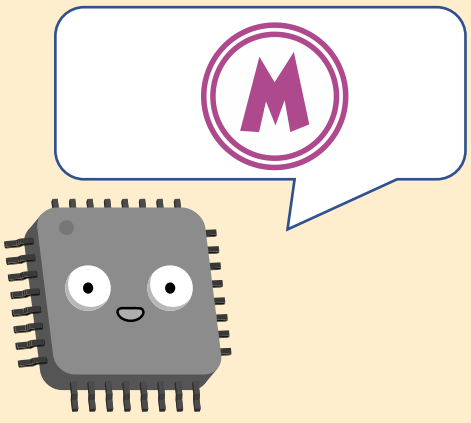
Stemie and Stemia's greatest desire is to visit as many planets as possible because their eyes always turn to the sky and the stars simply enchant them.

As they are already assembled, they start to review their original plans and decide to visit the Moon first.

To do this, they must prepare their spaceship at the mechanic store, so they decide to go there.



I hope you know in which unit the distance, or the way is measured. The units can be very small and very large.



Information

1 km = 1000 m
1 km ≈ 0,62 mi
1 m = 10 dm
1 dm = 10 cm
1 cm = 10 mm
1 ly = 9460730472580,8 km
1au =149 597 870 km

1. Arrange these units in ascending order:

For better understanding what is THE LIGHT YEAR scan the QR code or click HERE

cm, km, mm, m, dm, mile, the light year, the astronomical unit.

Just scan the QR code or click HERE

As you know, the shortest path between two points is a straight line.

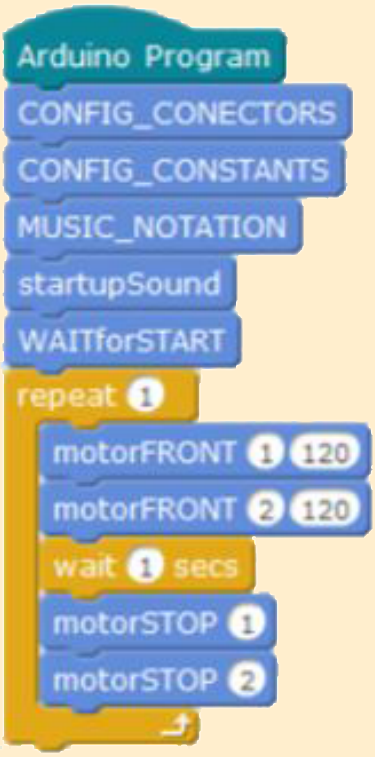
However, due to the accident they had in the asteroid field, Stemie and Stemia's navigational system was damaged and so they have some difficulties on moving straight.

Can you help them fix their navigational system and do straight lines so that they can get to the Moon faster?

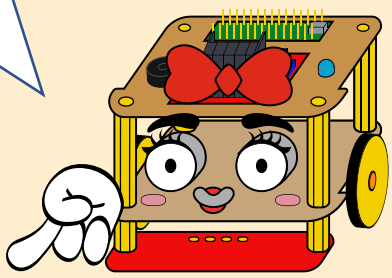
2. **Write a program to drive the robot straight:** In the sample program, on next page, the robot's motors run at 120 power and Stemie and Stemia run for 1 s.

NOTE: If the robot rotates more to one side, the engine power of that side opposite side can be changed, eg: 125.

Don't forget that usually values are set between 100 and 255.



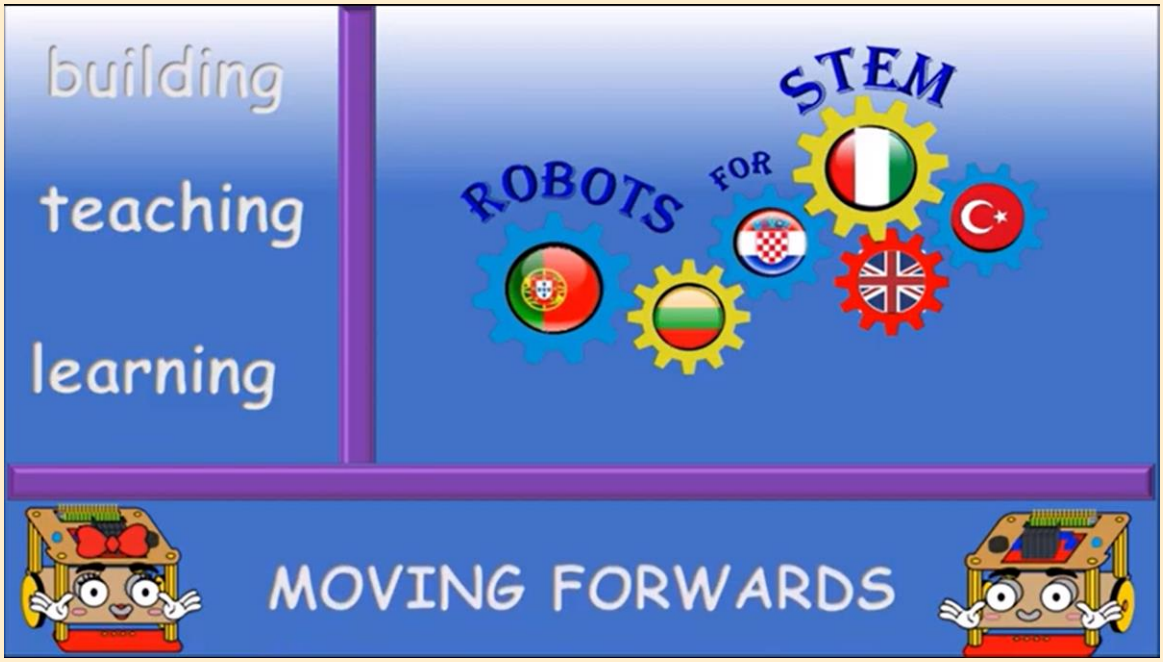
Take a look at the video on next page to understand how to send a program to your robot.



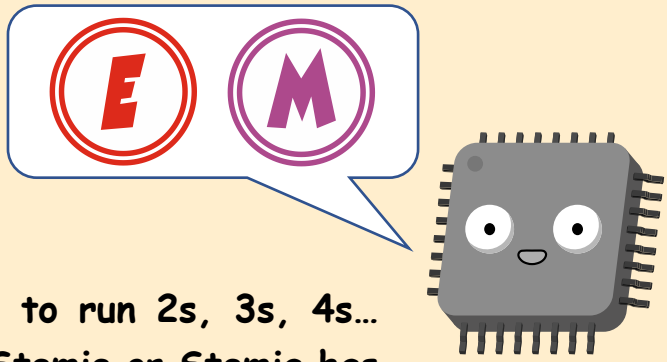
Discussion!

Have you succeeded?
What difficulties have you faced?

Your robot should behave like the one in the video below.



You will need a ruler so, you can use a math notebook where 2 boxes = 1 cm and do the ruler yourself.



3. **Change the robot program to run 2s, 3s, 4s… and measure the distance Stemie or Stemia has covered.**

Remember how many cm make a meter up and write the answers in cm and m.

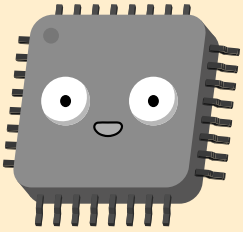
The power of both engines of the robot is 120		
Time travelled, s	Distance travelled, cm	Distance travelled, m
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

EXTRA TASK FOR FAST FINISHERS:

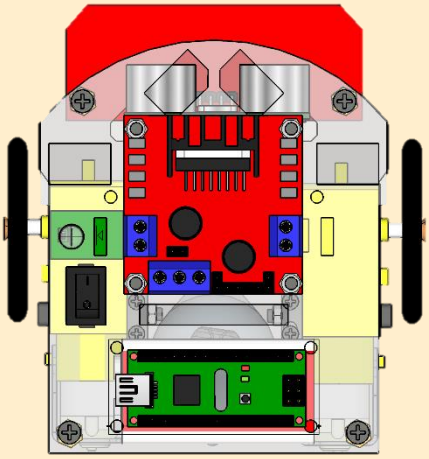
Program the robot to go 25cm, 4dm.

I think that you already know this but, just a reminder:

Motor 1, right side; Motor 2, left side.



MOTOR 2

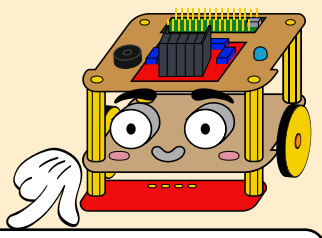


MOTOR 1

I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Name different measurements			
Program the robot to go straight			
Where can these ideas be applied in real word?			

CHALLENGE

2 Moving backwards



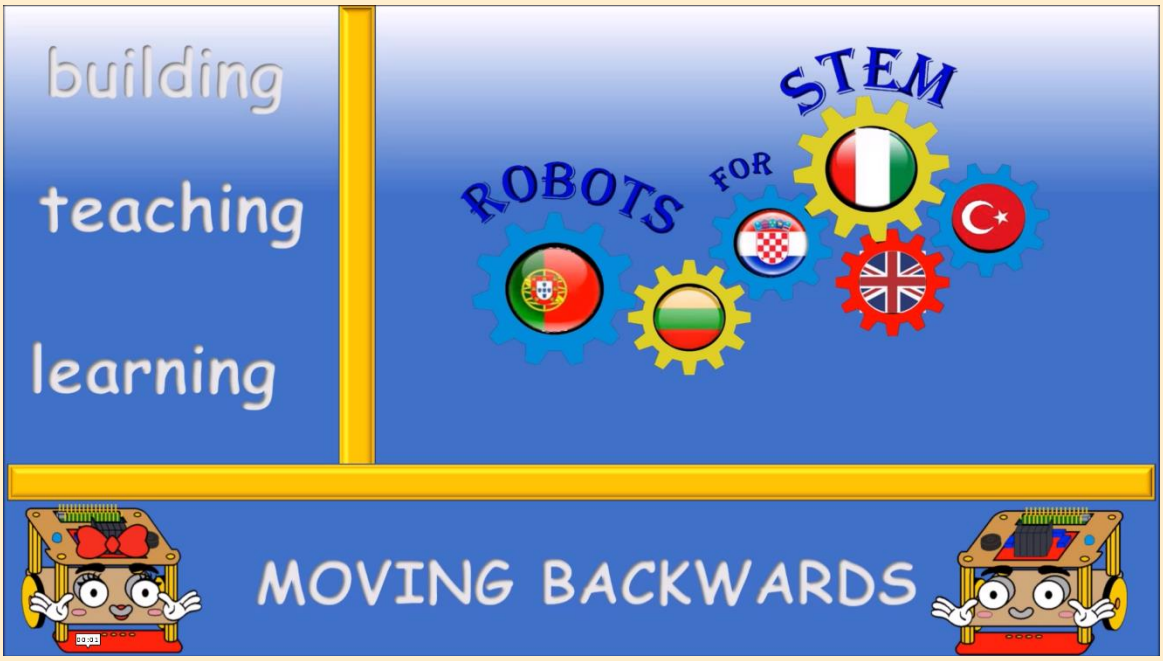
Please charge my batteries regularly so I can work at my best.

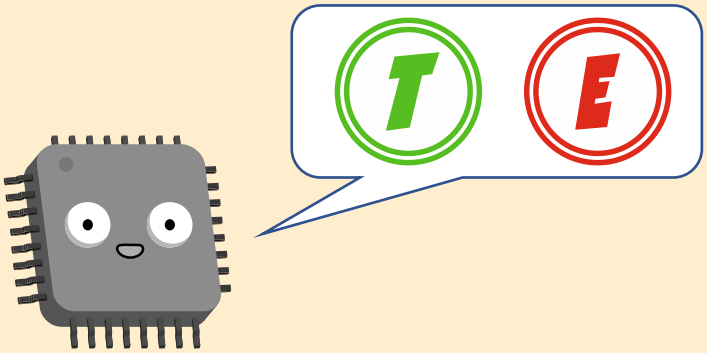
GOALS: I can draw parallel lines and program the robot to go backwards.

After they managed to move straight, it's very important to fine tune all systems. While doing that, Stemie and Stemia find that their gearbox is not working properly. They try to move backwards but something seems to be wrong.

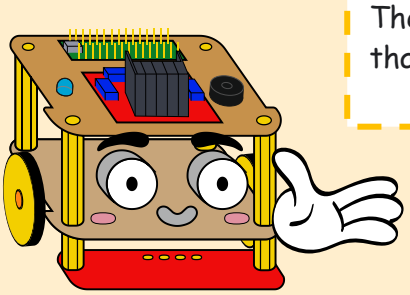
Its very important to have all gears working properly as they might need to divert from satellites and other obstacles they may encounter on their way to the moon.

Do you think you can help them fix that?





1. Write the program according to the provided example.

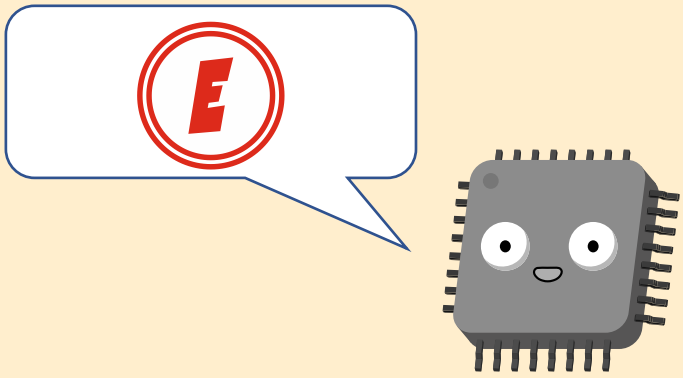


The part of the program that shows the reverse

Discussion!

Have you succeeded?

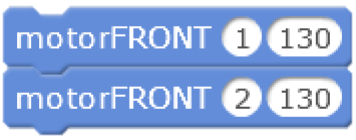
Is the robot going backwards?



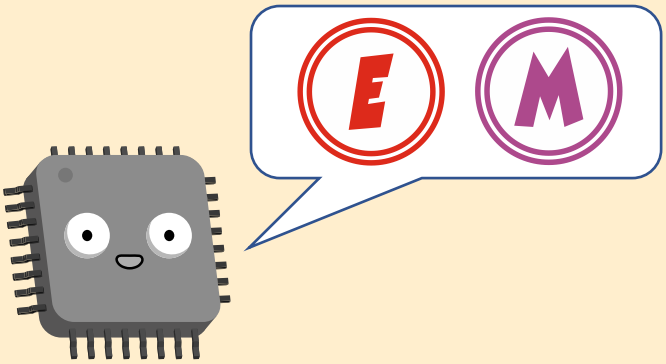
2. Write the program for the robot to move forwards for 2 seconds and then backwards for 2 seconds.

Backwards:

Forwards:

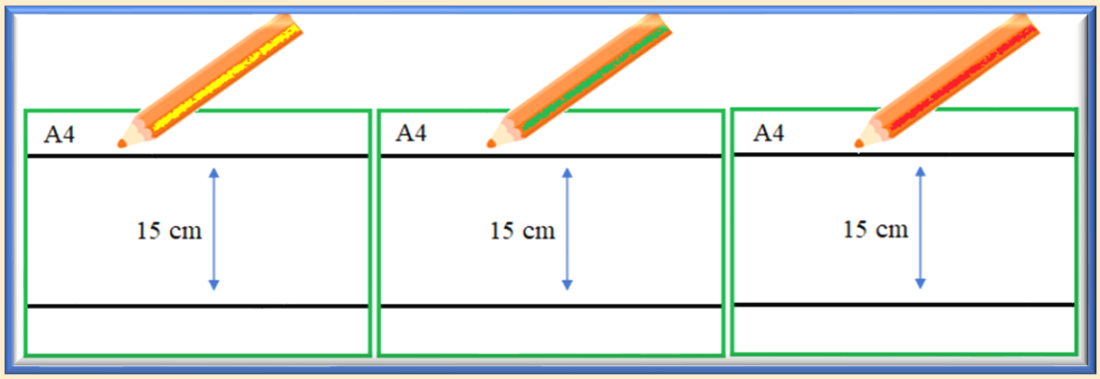


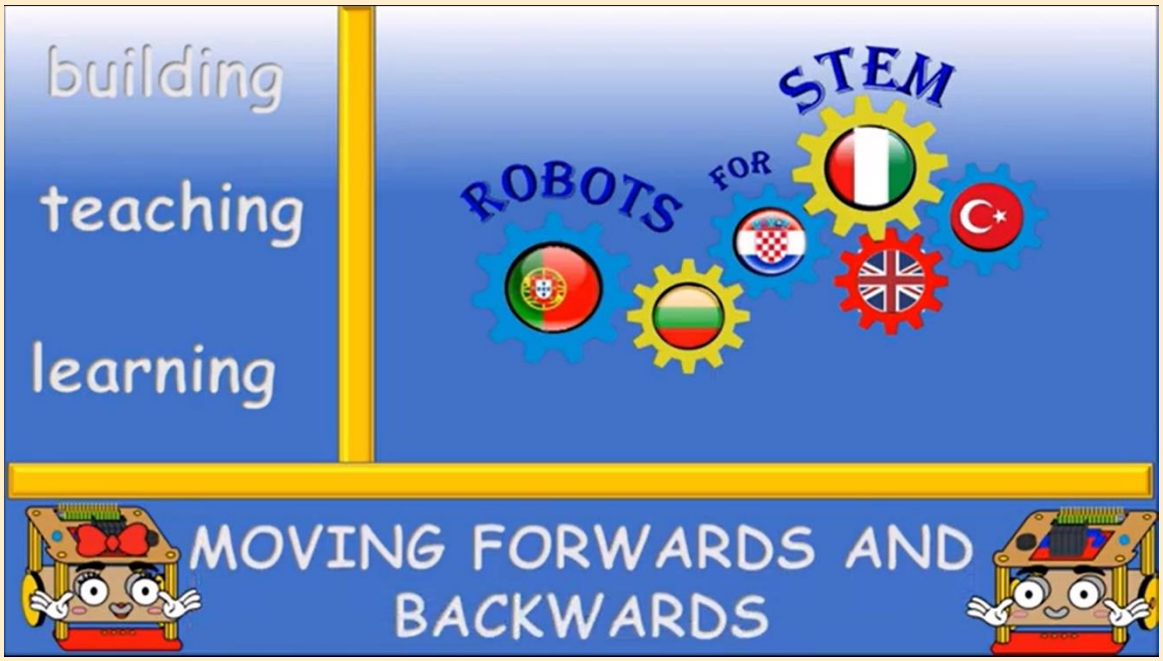
Is Stemie or Stemia back in the same place?



3. Do you know (remember) what are parallel lines?

You will need three A4 sheets. Draw two parallel lines on them, 15 cm apart. Put the sheets next to each other and fasten. It is a challenge. The robots must go forwards and backwards without moving over the lines. Let Stemie and Stemia compete together.

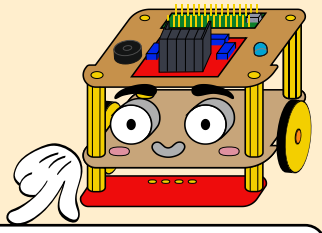




I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Draw parallel lines			
Program the robot to go backwards			
Where can these ideas be applied in a real word?			

CHALLENGE 3

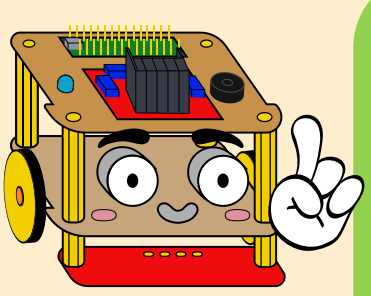
No time to go slow



Please charge my batteries regularly so I can work at my best.

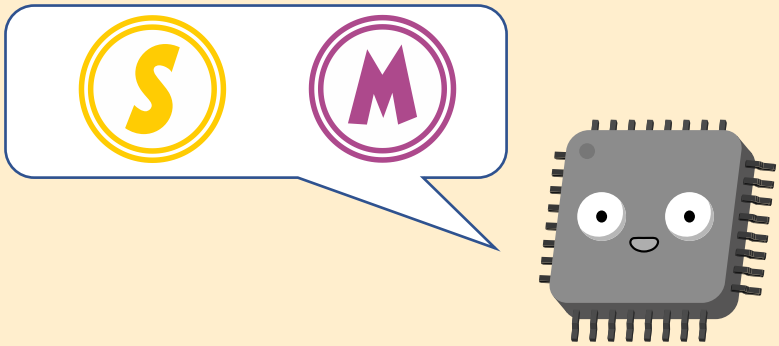
GOALS: I can calculate the speed of the robot and program it to go forwards and backwards.

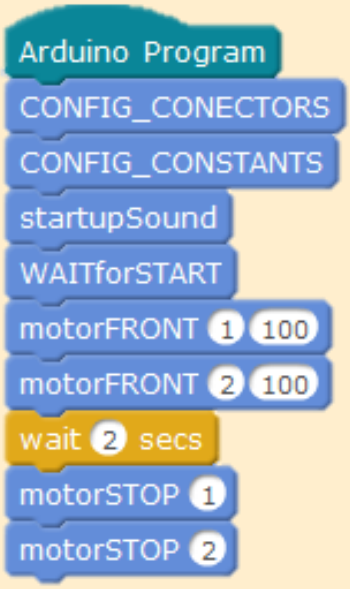
In preparation for their trip to the Moon, Stemie and Stemia find out that they need a lot of energy to travel when they are there, they might have to travel at their lowest and highest speed.
Your Mission is to help them find how fast they can go. Are you up to the challenge?



Do Stemie and Stemia know what their speed is? What does the speed depend on and what size of engine power does it need to be modified to change the Stemie and Stemia's speed?

NOTE: To calculate the speed, you need to know the distance travelled and the time it took to travel.





Complete the task. You will need large ruler.

•Write the program to run at 100, 2s for Stemie or Stemia.

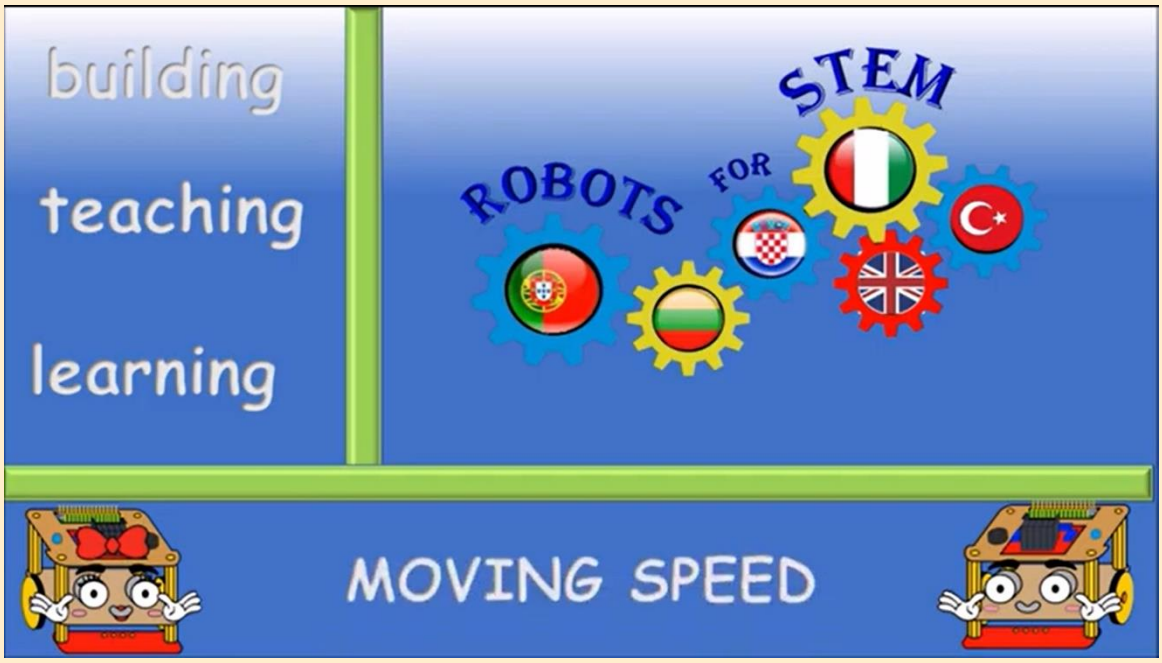
• Measure the distance the robot has travelled with a ruler.

• Calculate its speed by dividing the distance travelled by the time.

The formula:

$$v = \frac{S}{t}$$

•Change the power to that specified in the table and repeat the experiment.

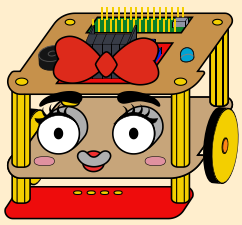


1. **Write down the results in a table, as Stemie and Stemia may need on their journey to the solar system.**

Stemie or Stemia is moving forwards			
The motor´s power	Distance travelled, cm	Time, s	Speed, cm/s
100		2	
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
210			
220			

Is your forward and reverse speed the same? I think your speed is a little slower when reversing.

Do you think the speed of Stemie or Stemia is changing as time goes by?



Measure and calculate the Stemie or Stemia's reverse speed. We hope you already know what program to write.

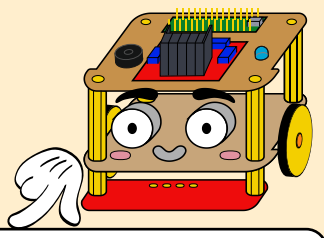
2. Write the results in the table.

Stemie or Stemia is moving backwards			
The motor´s power	Distance travelled, cm	Time, s	Speed, cm/s
100		2	
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
210			
220			

You know that the car can go at different speeds. Its speed on the highway, depending on the country, can be 120 km/h or 130 km/h, and in the city 50 km/h. The fastest animal - a cheetah can run at 120km/h. The fastest fish is black marlin, which can sail at a speed of 132 km / h and even surpass a submarine. And one of the slowest animals, the sloght, can only travel at 0,186 m/h, and the turtle at 2,7 m/h. The cosmic speed required for the machine to rise from the ground and rotate around it is 7.9 km/s.

I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Calculate the speed of the robot			
Program the robot to go forwards and backwards			
Where can these ideas be applied in real word?			

CHALLENGE 4 Moving in orbits



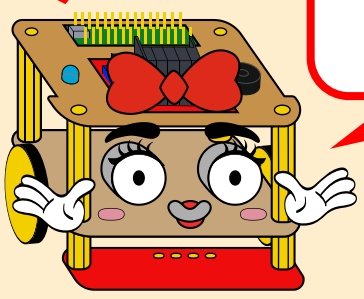
Please charge my batteries regularly so I can work at my best.

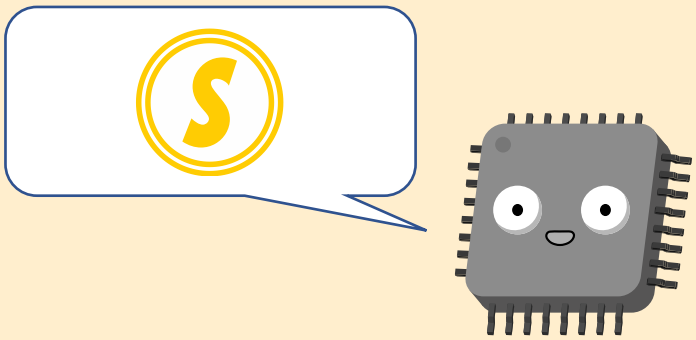
GOALS: I can list the planets according to the distance from the Sun, size and program the robot to go in a circle and a shape of an athletic track.

Stemie and Stemia's greatest dream to continue travelling through the Solar System. What do you know about the Solar System? I'm sure you know all eight planets in the Solar System, and you can sort them by distance from the Sun.

I know how to remember the order of the planets: Mercury, Venus, Earth, Mars, Jupiter and *SUN*.

SUN is Saturn, Uranus and Neptune. A great way to remember more easily.

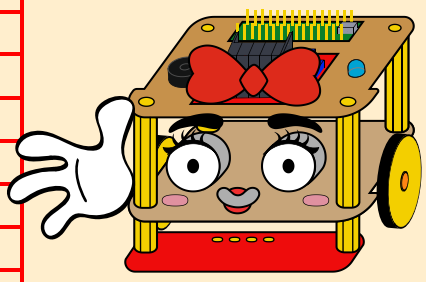




1. Line up the planets in the order of the Sun's distance:

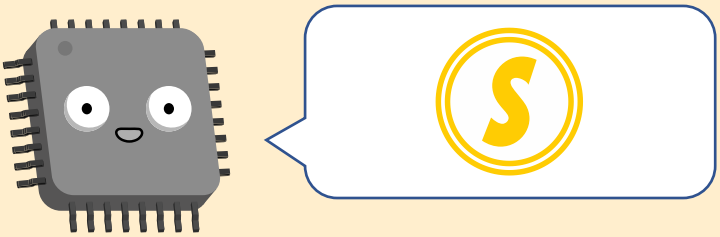
Jupiter, Mars, Mercury, Neptune, Saturn, Uranus, Venus and Earth.

SUN	
1	
2	
3	
4	
5	
6	
7	
8	
9	



The biggest distance									The smallest distance

Just scan the QR code or click HERE



2. Maybe you know which planet is the largest and can line them from the largest to the smallest?

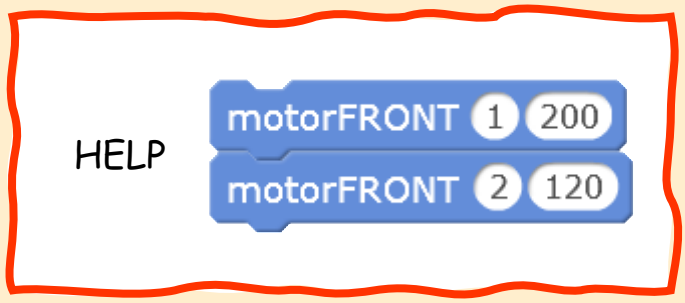
Just scan the QR code or click HERE

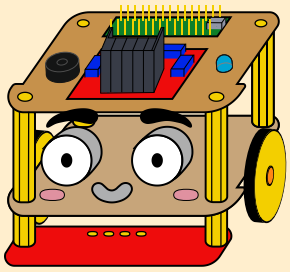
As you know, Stemie and Stemia are always curious about the world around them – they love to learn new things. To prepare for this journey, they studied astronomy, learning about how planets orbit around stars.

Now they know that it takes a whole year for Earth to revolve once around its Sun. They also know that orbits by planets around stars have the shape of an ellipsis, one that is almost a circle, with the star at the orbit's centre. The same shape happens when a moon orbits a planet: let's help Stemie and Stemia practice a circle so that they can revolve around the Moon.

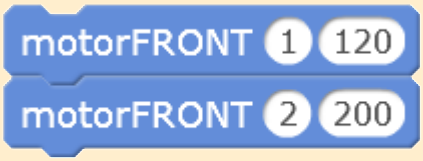
3. Write a program to make the robot move in circles.

HELP

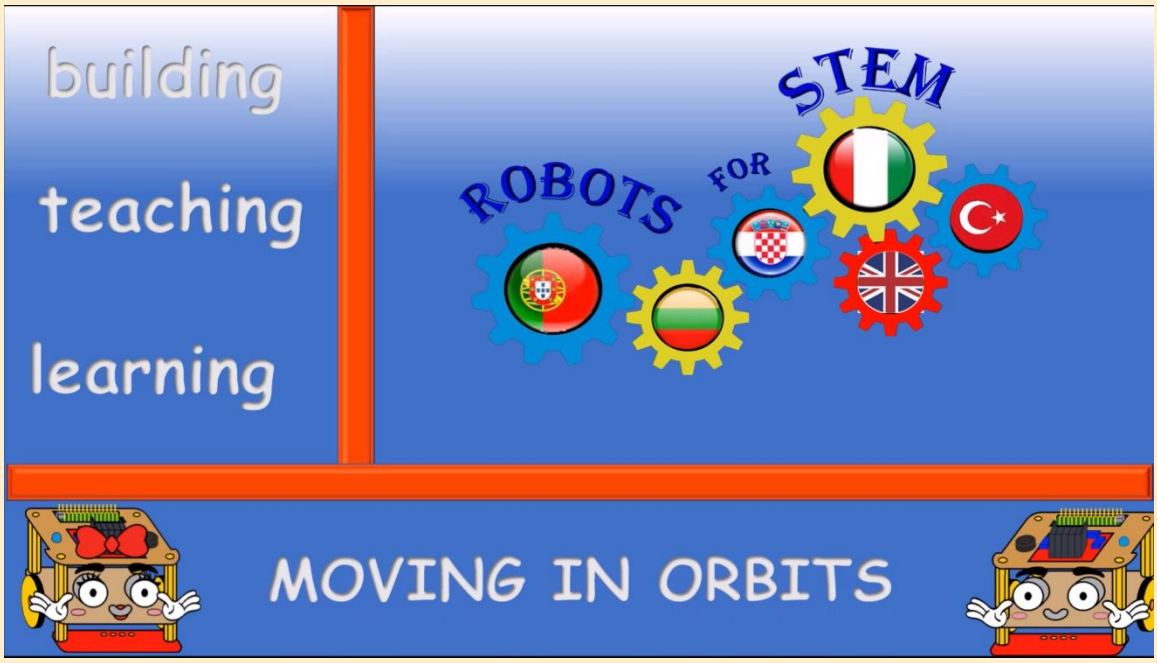


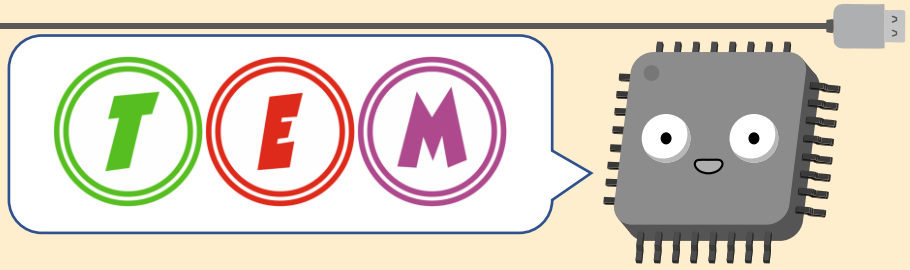


And what happens if you write it like that?

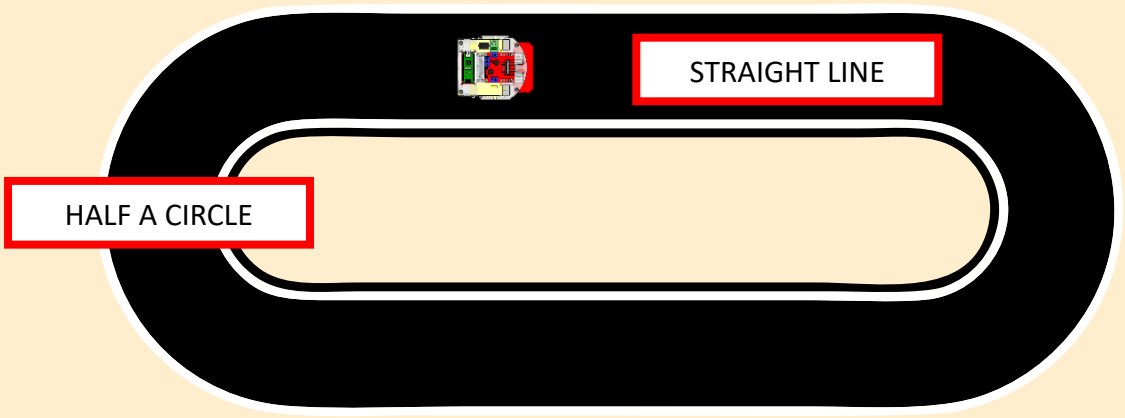


Discussion!



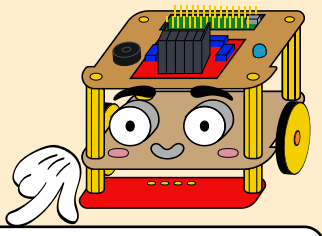


4. **And now another challenge. Can the robot ride in a straight line and a circle, like in an athletic track?** Use the next scheme as reference.



I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
List the planets according to the distance from the Sun			
List the planets according to the size from the Sun			
Program the robot to go in a circle			
Program the robot to go in shape like an athletic track			
Where can these ideas be applied in real word?			

CHALLENGE 5 Making sounds



Please charge my batteries regularly so I can work at my best.

GOALS: I can name what is needed to make a sound, program the robot to play the music and measure the volume.

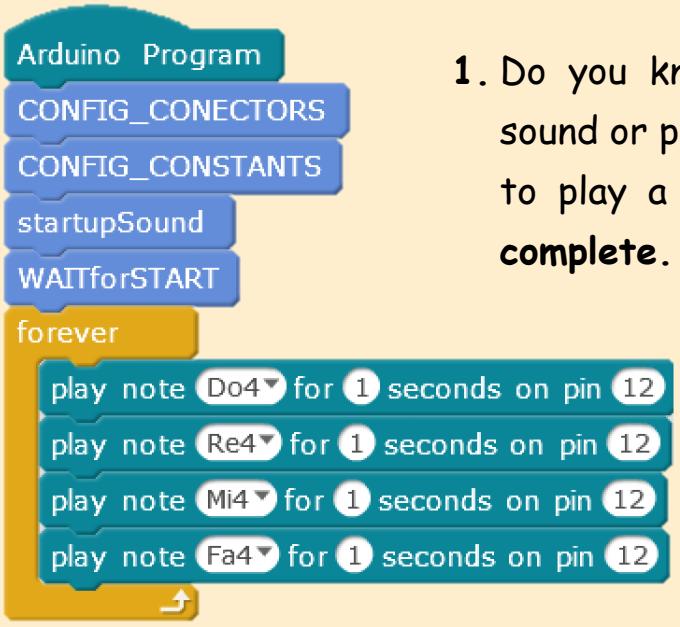
With your help, Stemie and Stemia finally arrived at the Moon, the Earth's only natural satellite. The Moon orbits Earth in an elliptical orbit, so it is not always at the same distance from Earth.

Our friends are so excited that they decide to play a music.

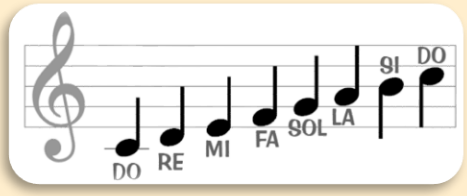
To read more about the Moon scan or look HERE

You can scan the QR code or click HERE and try different sounds.

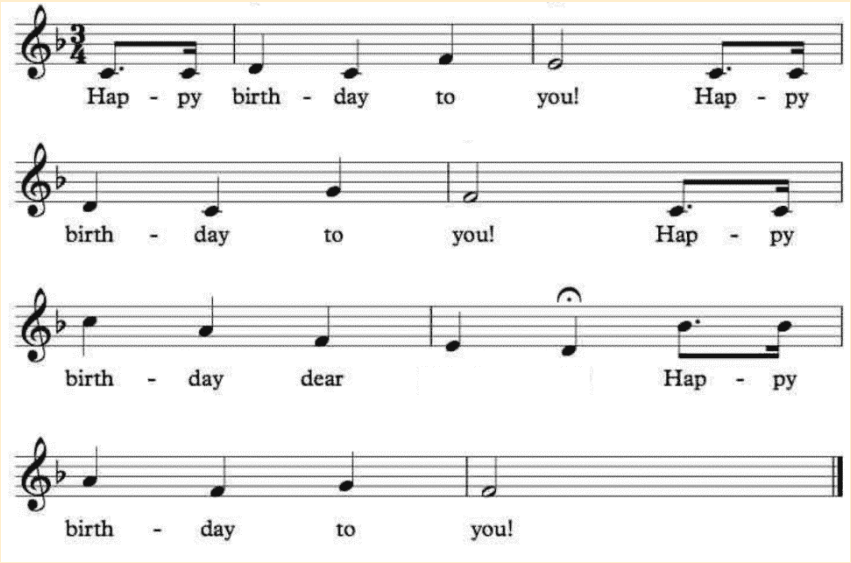
All sounds are caused by mechanical ambient vibrations, although they are usually not visible. When cars collide, their surfaces begin to fibrillate, and we hear the sound of a crash; music from the radio receiver comes from the membrane of its speaker; we speak and sing as the voice strings vibrate in our larynx. Sound waves can only propagate in environments where there are particles: *air, liquids, solids*. The sound does not propagate in a vacuum. The average speed of sound in the air is 330m/s. Human audible sound is from 16 to 20000Hz. This means that between 16 and 20000 vibrations must occur in 1s and then we can hear. Not everyone will hear a sound of 16 or 20000Hz.



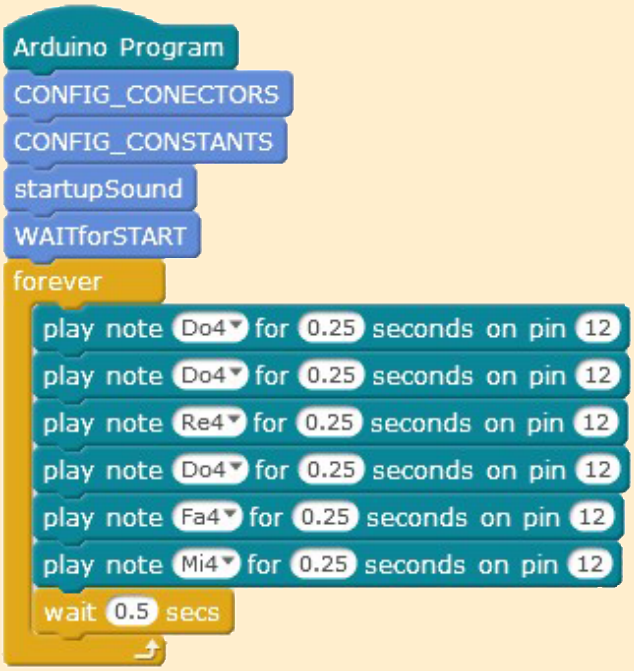
1. Do you know your robot can make a sound or play music? What does it take to play a scale? **Try this and then complete.**



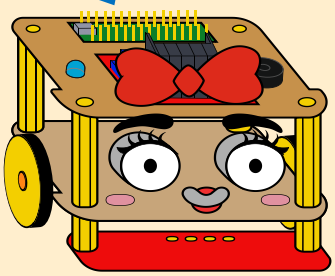
2. Now try to extend the following melody. Maybe you know what song it is? You can change the tones and try to program it.



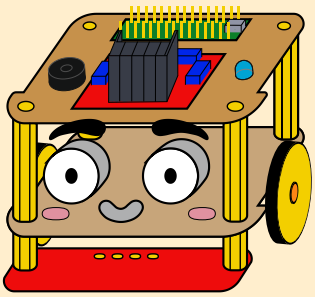
Example:



Have you heard? "Jingle Bells" became the first song played in space when, on 16 December 1965, it was broadcast during NASA's Gemini 6A space flight.



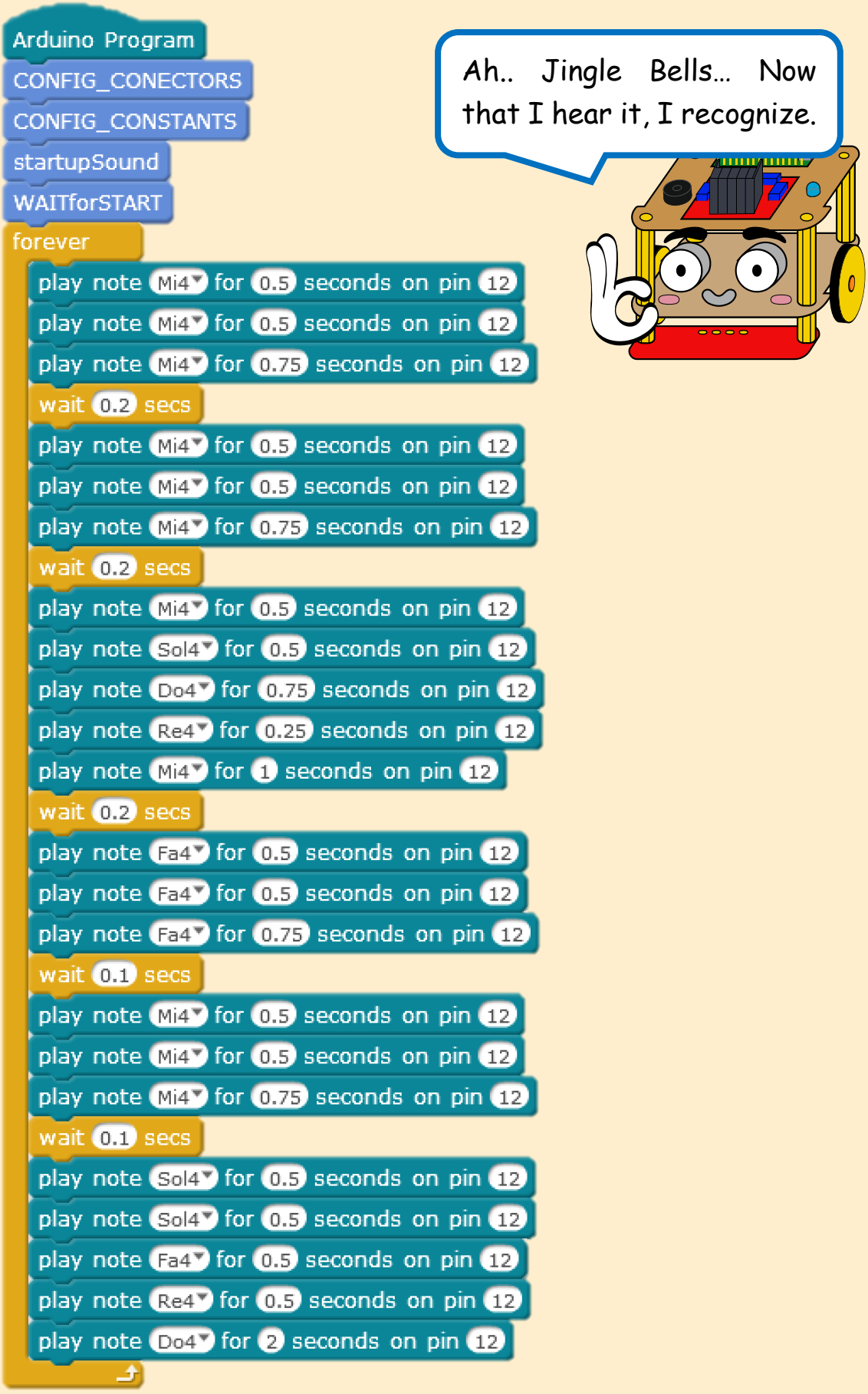
I do not understand how the music could sound in space if there is no air!



If you want to learn more about music in space, you can scan the QR code or click HERE

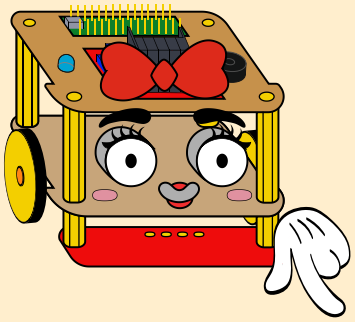
3.Why don't you try to write your favourite song. Search for the notes online and try making Stemie or Stemia play it.

If you face difficulties, see how it worked for Stemie and Stemia when they programmed the music of "Jingle Bells". Maybe you can do it better.



The sound intensity is measured in decibels. The range of sound intensity from hearing to the pain threshold corresponded to a loudness range of 0 - 130 dB. Normal human language is 50-60dB.

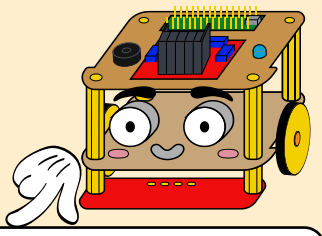
Stemie and Stemia decide to measure the volume while they sing.



3. **Follow the instructions on the previous video and measure the volume of sound your robot emits.**

I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Name what is needed to make a sound			
Program the robot to play the music			
Gauge the volume			
Where can these ideas be applied in real word?			

CHALLENGE 6 Flashing lights



Please charge my batteries regularly so I can work at my best.

GOALS: I can program the robot to turn on the lights in every colour of the rainbow.

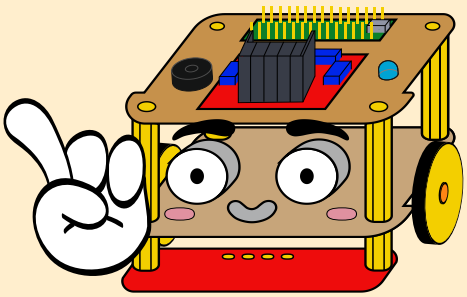
Stemie and Stemia continue their adventures on the Moon. Not to lose from each other among cliffs and mountains, they decide to turn on their LED lights and communicate with each other using light signals.

Light is emitted by many bodies: the Sun, stars, a light bulb, or a candle. However, we also see other objects: a table, a book, the Moon... They are visible because the light reflected from them enters our eyes.

When the light bulb is turned on, the whole room is immediately illuminated. In 1676, the Danish astronomer Olas Remer, based on the duration of the hasten and delay of Jupiter's satellite, determined that light travels at a speed of 300,000 km/s. He did it perfectly, the exact value of the speed of light now determined is 299792458m/s. The speed of light is slightly reduced when traveling through various transparent environments.

In 1666, Newton managed to split light into a spectrum of seven colours: red, orange, yellow, green, cyan, blue and violet. Consequently, the white colour is composite.

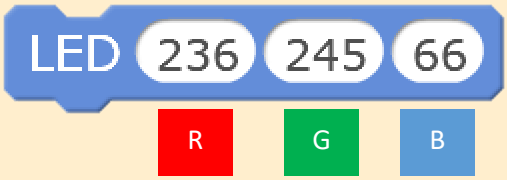
Look at the model of Newton's experiment: just scan the QR code below or click HERE.

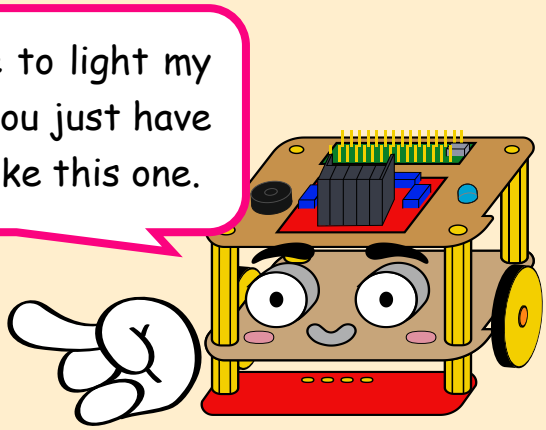


Red, green and blue are the primary colours and the mix of them produces other colours.

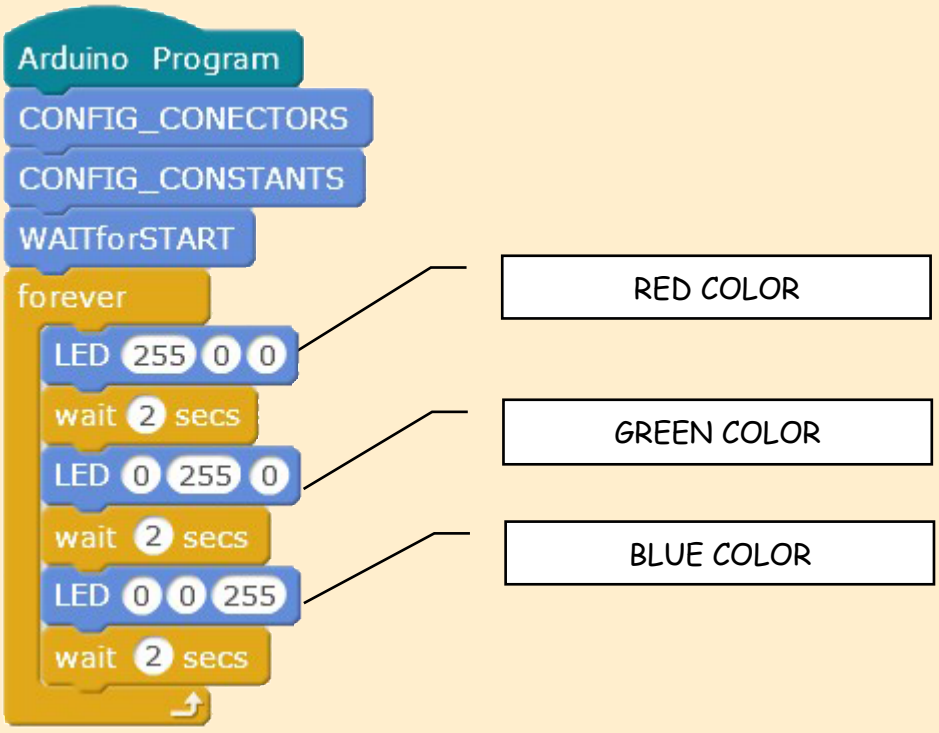
Just scan the QR code or click HERE to see an example of how it works.

RGB
236, 245, 66



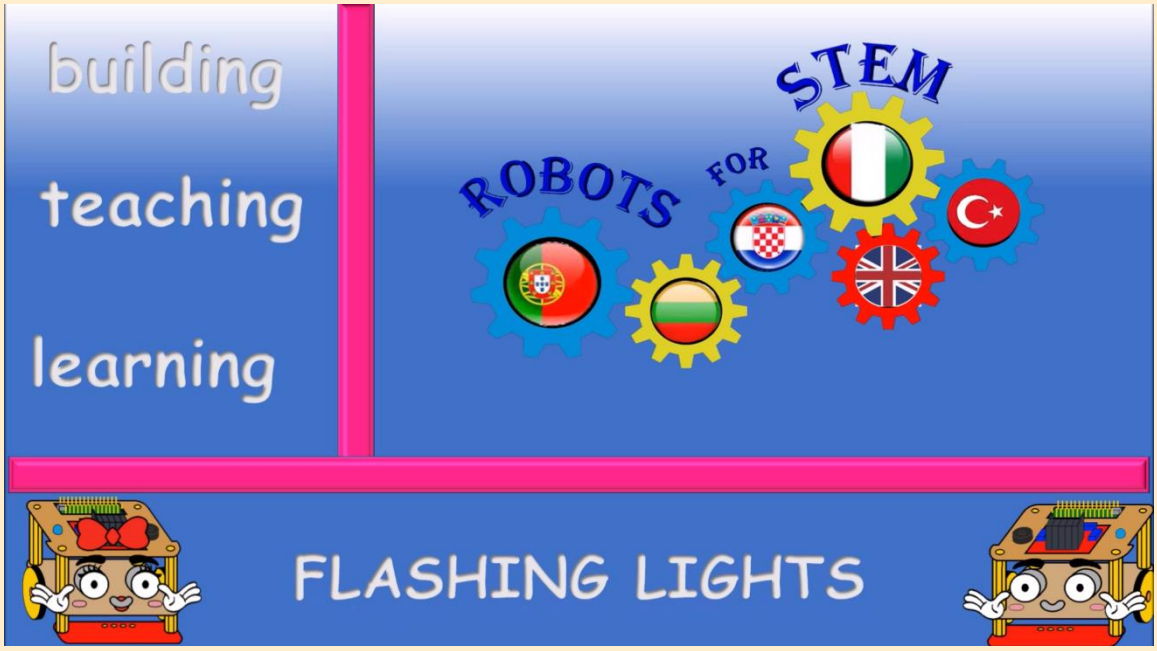


1.Try turning the robot's LED on. You will need to write a program like this:



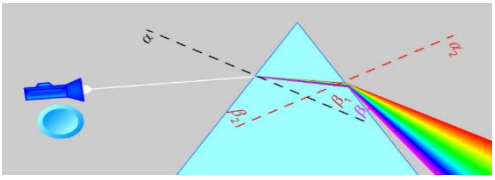
If you want to create your own colours, you can find the RGB colour codes HERE.

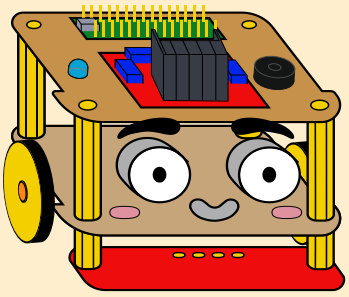
2.Write a program for all the colours of the rainbow. And look how it worked for Stemie and Stemia.



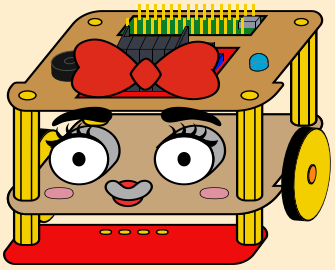
Note: RGB colour codes are coded using numbers from 0 to 255.

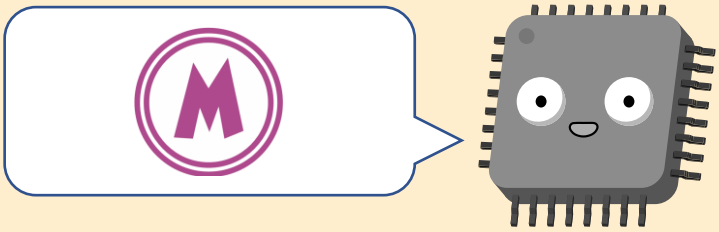
Do you know why the red colour is at the top?





Oh yes! Red is the fastest and has the longest wavelength. It is least absorbed by air, dust, and water. Therefore, we use it for prohibition signs.



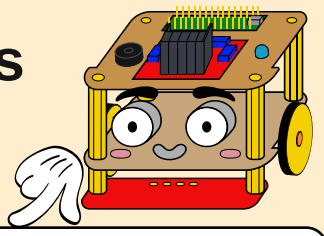


3.The average distance from Earth to the Sun is 1 av = 149,597,870 km. Calculate how long does light and sound take to travel this distance (if there is air).

I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Program the robot to turn on the light in every colour of the rainbow			
Where can these ideas be applied in real word?			

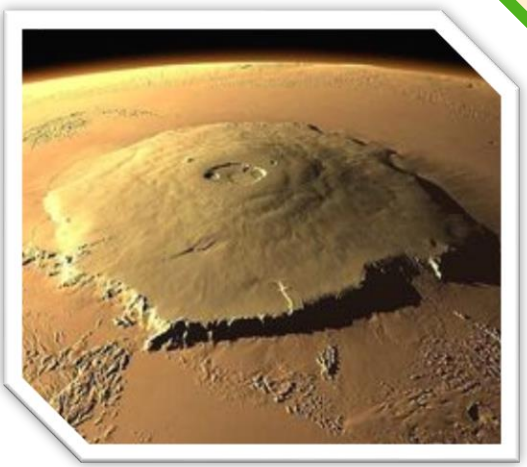
CHALLENGE

7 Creating Sequences and Loops



Please charge my batteries regularly so I can work at my best.

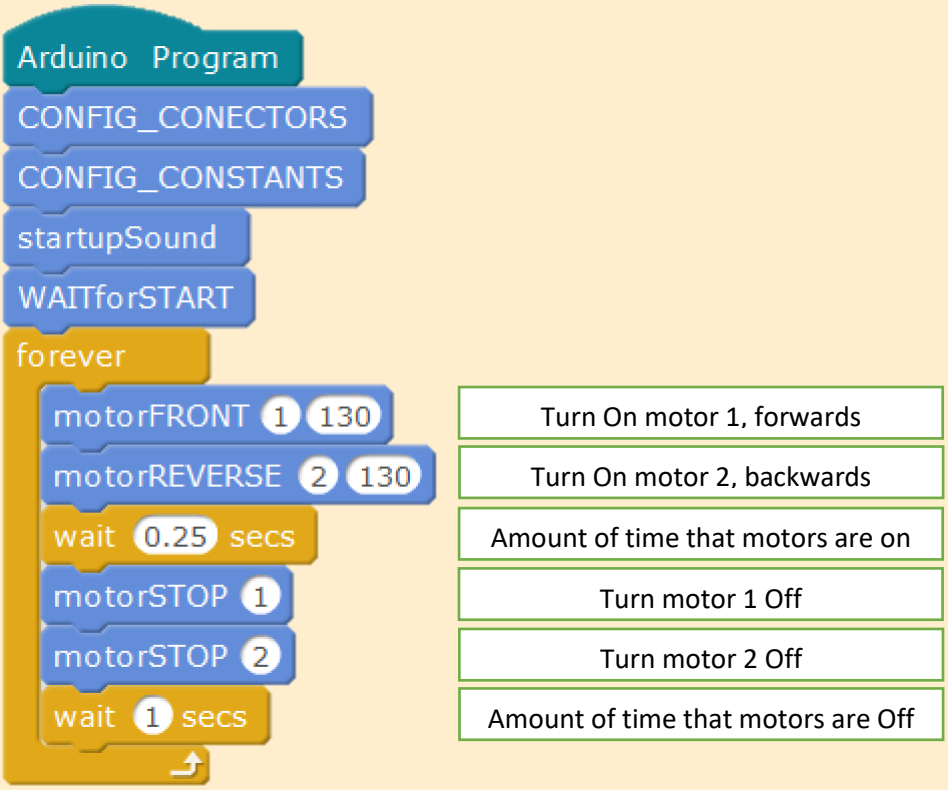
GOALS: I can name the highest mountain on Mars and program the robot to go in a square and a rectangle.



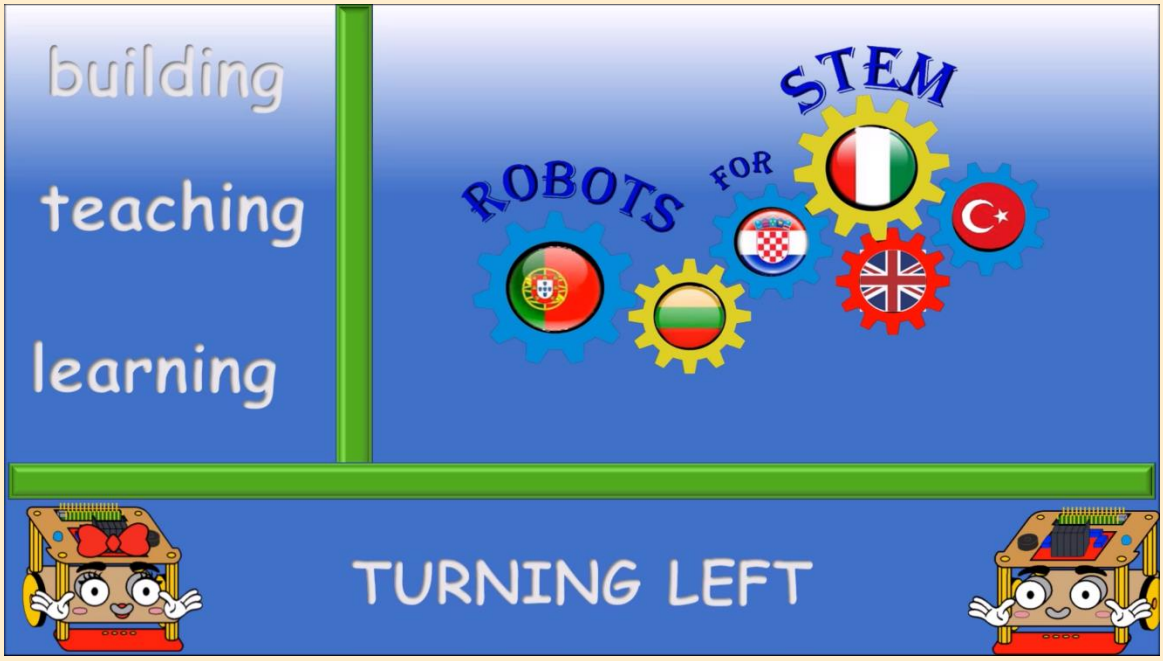
After their adventures on the Moon, Stemie and Stemia board their spaceship so they can finally reach Mars. Once there, they become very excited to see the highest known mountain in our Solar System – a shield volcano called Olympus Mons, 25 km high, with a diameter around 624 km. If we define a square within this mountain to the edge of its circumference, the square's diagonal would be equal to the volcano's diameter – 624 km – with four equal sides, each being about 441 km. They wonder how long will it take to make it around this giant mountain?

It's challenging to imagine 624 km. For example, Portugal's length is about 578 km. So the whole country could fit in this mountain.

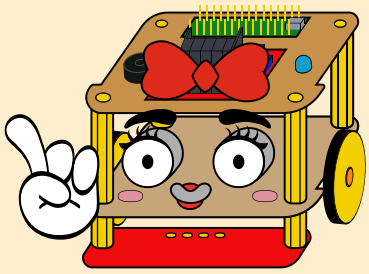
1. **Can the robot turn? First, write a sequence of commands to make the robot turn 90 degrees.**

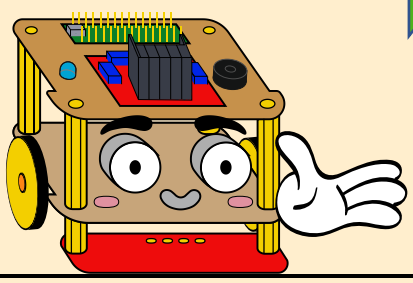


NOTE: Take a sheet of A4 format and test whether the robot turns correctly.
If the turn is too small, increase the turning time or speed.
If the turn is too large, reduce it.
Stemie and Stemia will help you do this.



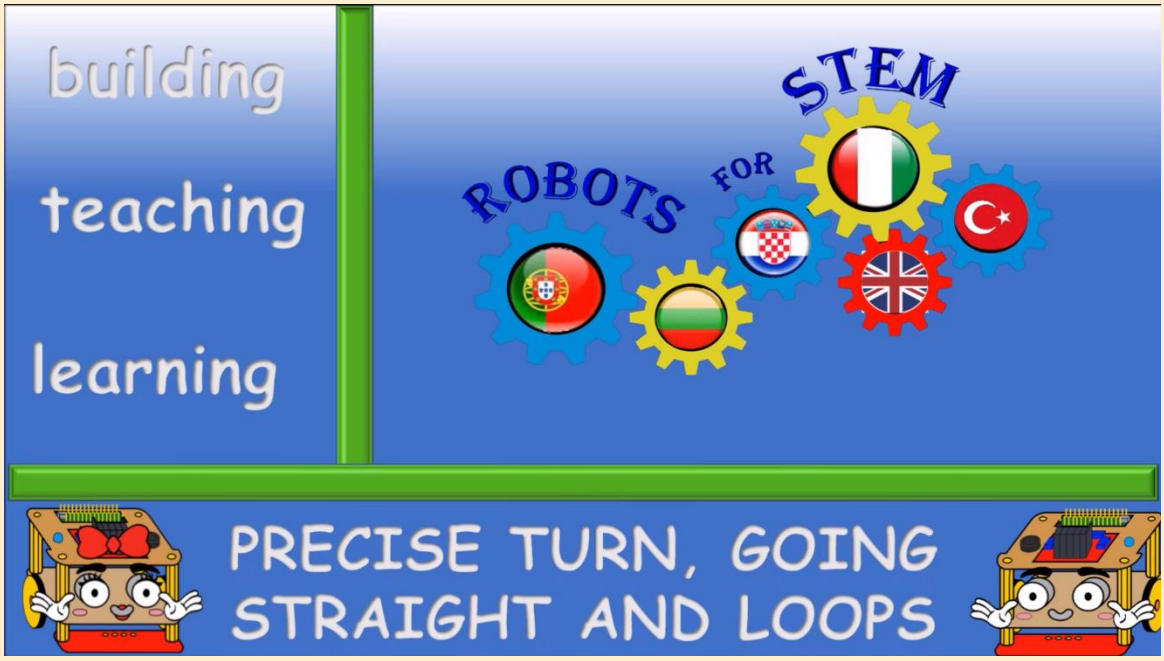
Think about what you need to change in the program if you want me to turn right?





Now that I can Turn, can you make me drive in squares?

2. Write a sequence of commands so that the robot goes straight for a moment and then turns 90 degrees.




```
motorFRONT 1 120
motorFRONT 2 120
wait 1 secs
motorSTOP 1
motorSTOP 2
wait 0.2 secs
motorFRONT 1 100
motorREVERSE 2 130
wait 0.3 secs
motorSTOP 1
motorSTOP 2
```

Moving forwards for 1 second.

Don‘t forget to used the motor speeds you discovered on Challenge 1

Turning 90 degres to the left.

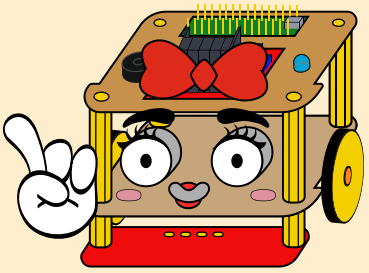
Don‘t forget to use the time and speeds that you discovered in the previous problem.

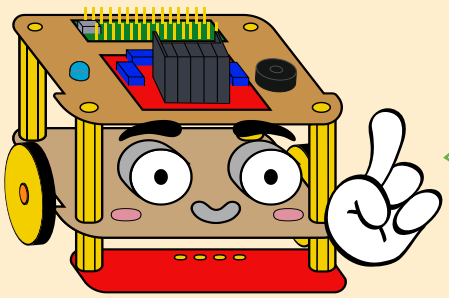
3. The robot has to go around Olympus Mons.
   Try to improve the above sequence so that the robot's path describes a perfect square.
   Repeat this sequence 4 times.

Repeat 4 times? Hum..

Ah.. of course.. a Square has 4 equal sides.

So, that's what **Loops** are for!

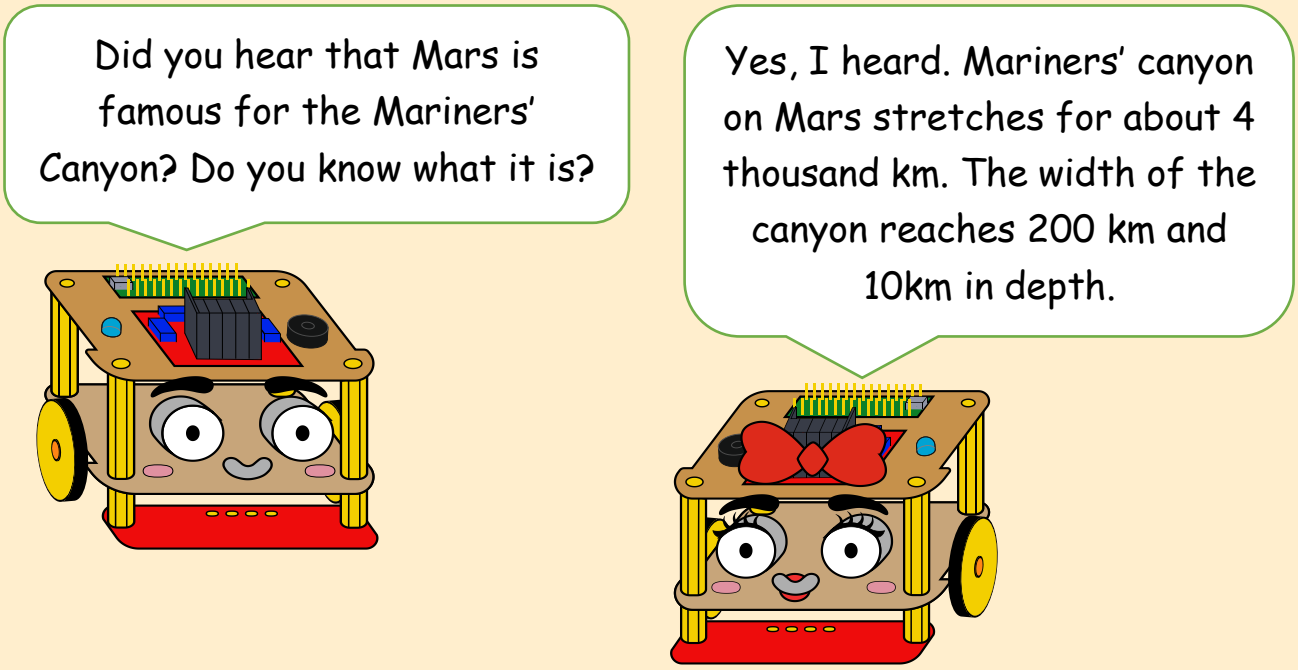




Have you noticed the use of the words **Sequence** and **Program**?

A sequence of commands, used to perform a certain task, can also be called a program.

Stemie and Stemia do not stop surprising each other with their knowledge of Mars surface.



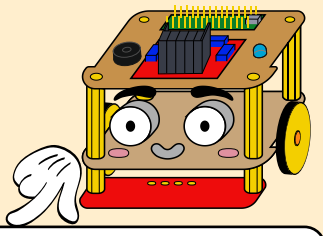
4. **Calculate the area of the rectangle when the robot has to go around Mariner Canyon. Program the robot to go in a rectangle with Sequences and Loops.**
   Don't forget that a rectangle does not have 4 equal sides.

Remember how to calculate the area of a rectangle.

$$S = a \cdot b$$

I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Name the highest mountain on Mars			
Program the robot to go in a square			
Program the robot to go in a rectangle			
Where can these ideas be applied in real word?			

CHALLENGE 8 Organizing thoughts



Please charge my batteries regularly so I can work at my best.

GOAL: I can program the robot using procedures.

While **Stemie** and **Stemia** are enjoying themselves on Mars, **At** is trying to repair the massive spacecraft engines...

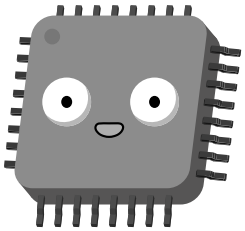
But, how to achieve cosmic speed to go back home? What engines can give a spacecraft such an enormous speed?

At knows that Rocket operation is based on inertia. Liquid hydrogen and oxygen tanks are installed in the rocket body. Hydrogen is the combustible component and oxygen is the oxidizer. When these substances are injected into the combustion chamber, they ignite, and the resulting fuel rushes through the nozzle in a jet.

The reaction force is directed in the opposite direction. Under the influence of this force, the rocket goes up.

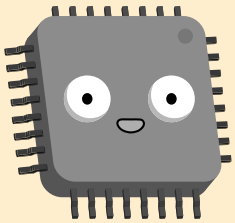
When part of the fuel is used up, the container that contained the fuel separates from the rocket, thus providing additional speed and reducing mass.

I remember now! Such rockets are called multi-stage.

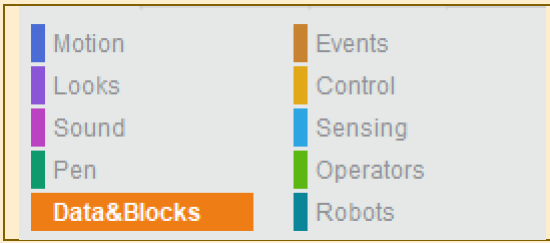
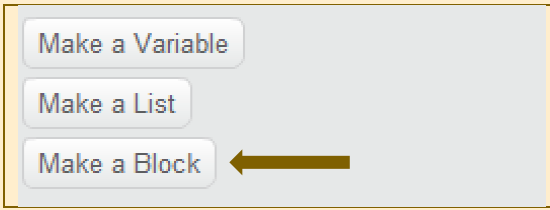
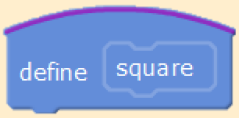
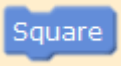


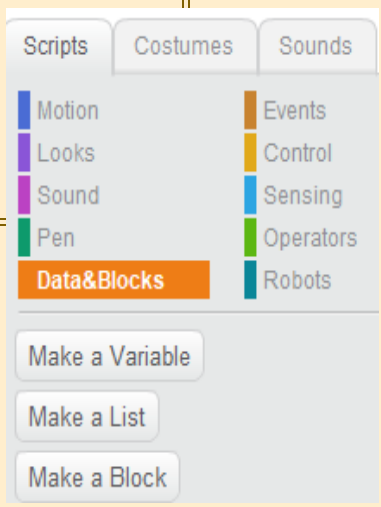
You can see how it looks HERE or scan the QR code.

NOTE: Rocket operation is based on the division of large work into smaller ones. When programming, if you create large programs, some problems may arise: the text becomes confusing; it is difficult to remember variables; there are many repetitive actions; etc. There is only one solution - to divide the program into independent code modules that complete specific tasks called **Procedures**.

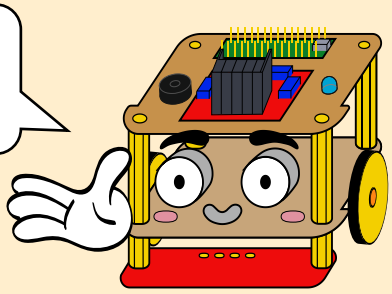


How to create procedures?

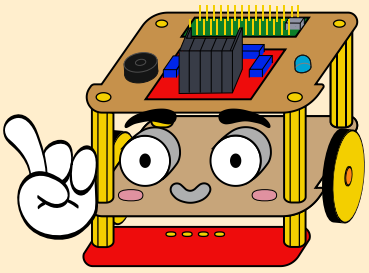
Go to the **Data & Blocks** Category	
Choose the button	
In the New Block dialog, write the name of the procedure	
A procedure header block will be created in the Code Area	
In the Block palette, a new block will be created which is a program call to the procedure	



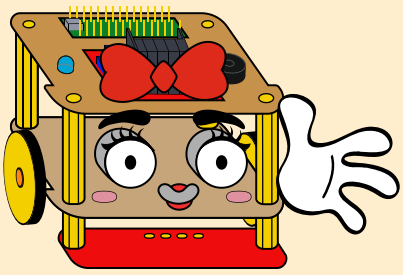
I'm starting to feel organized!



Do you really know how to write a program to drive a square? It should look similar to this.

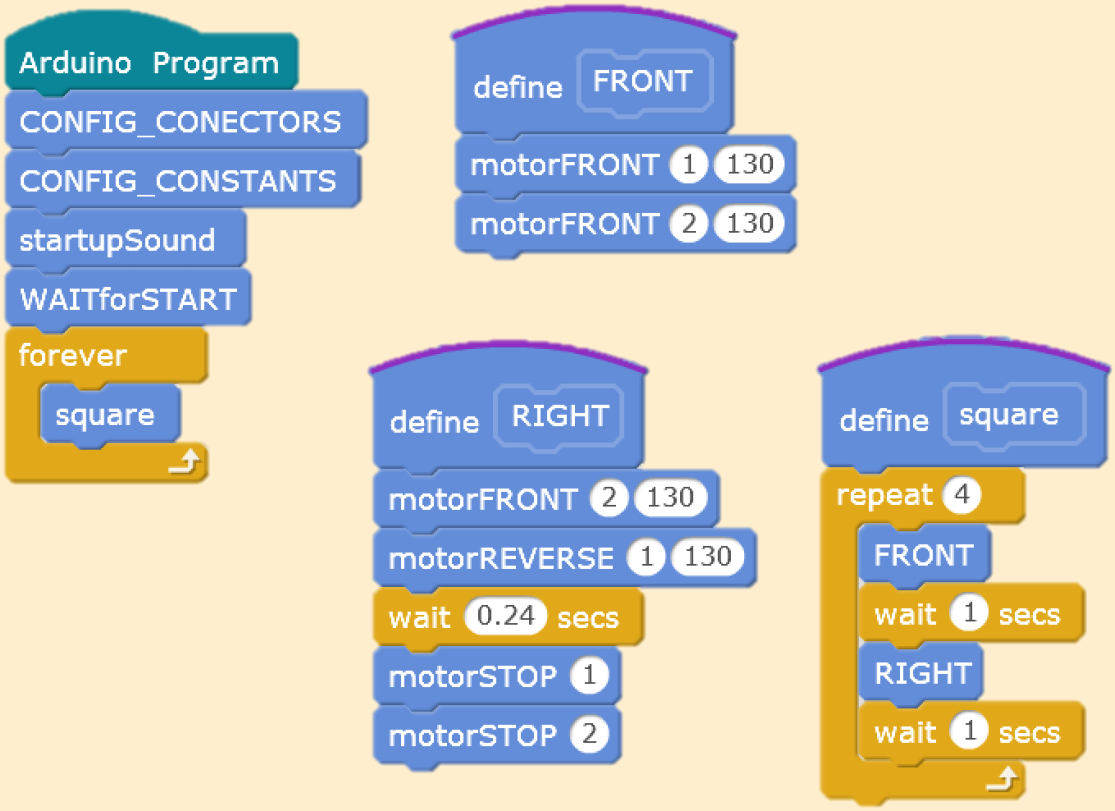


And this is what a procedure call looks like.

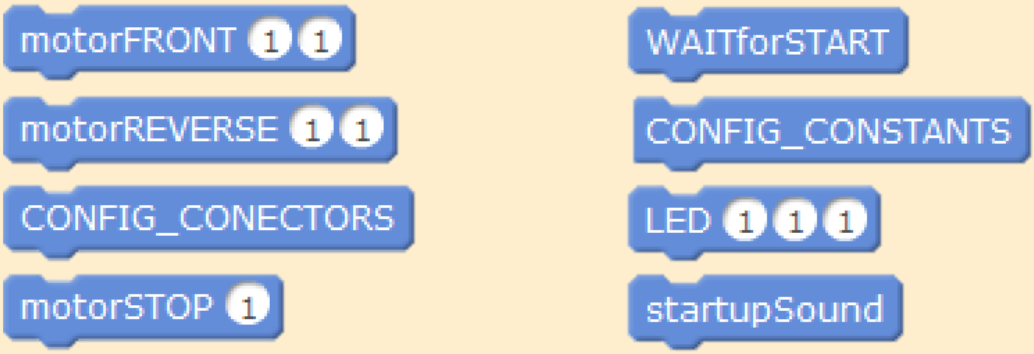


NOTE: Block names can't have any spaces. For example, it's impossible to create a block named SQUARE 1 and another one named SQUARE 2. Instead, you can create SQUARE_1 and SQUARE_2.

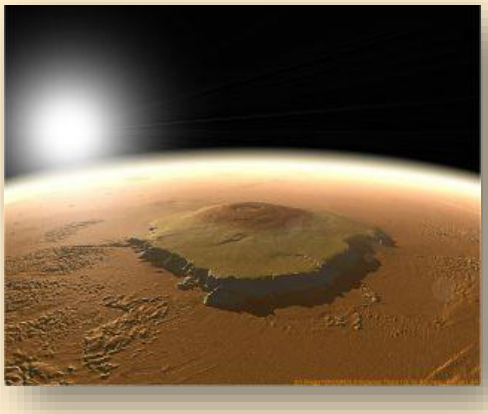
It is possible to write even more simply, use shorter procedures.



If you take a peak there are some Procedures created on your Stemie project. Moreover, you've already used some of them:

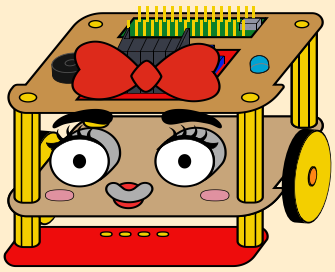


1. Stemia and Stemie are on Mars and want to go around the canyon and Olympus Mons. Remember what shapes do they need to be able to get around?
   Write a program for their journey using procedures.

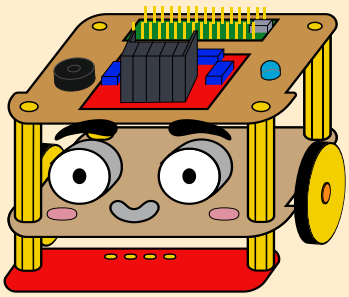


2. **Can you organize all blocks that you have made until now?**
   For example… music blocks can be placed under a procedure named HappyBirthday; blocks that make your robot turn left, should be under a procedure called TURN_LEFT, and so on…

I heard that the first rockets were invented by the ancient Chinese. In the 10th century they were used to launch metal-tipped arrows from a bow.



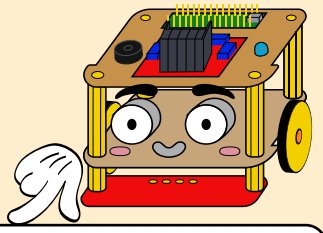
And I heard that in the 17th century Lithuanian scientist Kazimieras Semenavičius was the first to put forward the idea of a multistage rocket and rocket artillery.



I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Program the robot using procedures			
Where can these ideas be applied in real word?			

CHALLENGE

9 Following trajectories

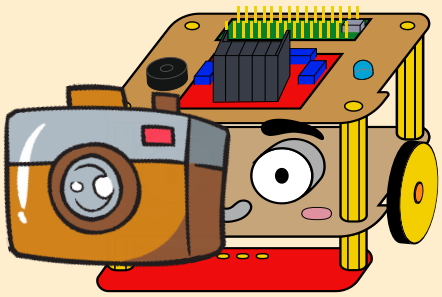


Please charge my batteries regularly so I can work at my best.

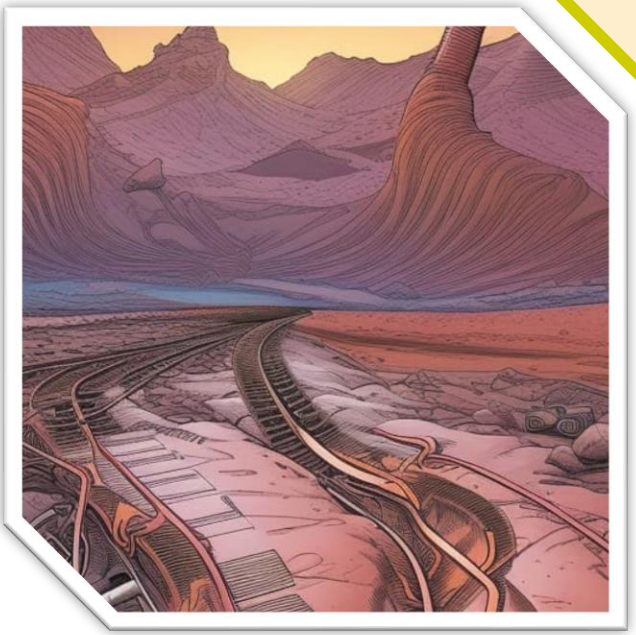
GOAL: I can program the robot to follow a line.

INFO: Mars is the closest planet to Earth in terms of living conditions. And not only the Olympus Mons is famous, but also the Mariner Valley, a system of canyons parallel to the Martian equator that extends for about 4,000 km. Mariner Valley is much larger than the canyons on Earth, and is the largest known similar formation in the Solar System. Mariner Valley was discovered by the Mariner 9 spacecraft in 1972.

More about the Mariner Canyon scan the QR code or click HERE

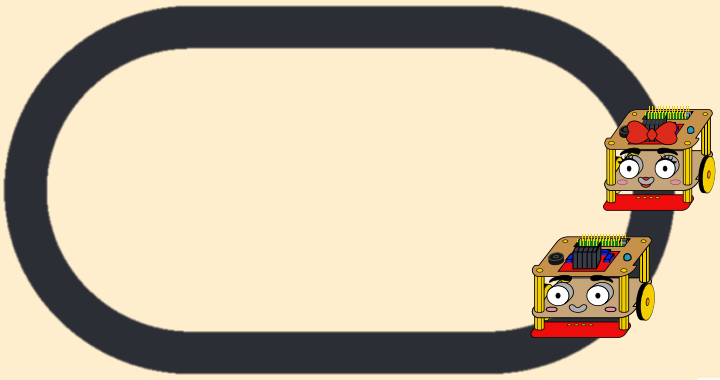


Stemia and Stemie want to look around Mariner Valley going along its rim. They find some old and previously unseen tracks and decide to follow them to see where they lead.



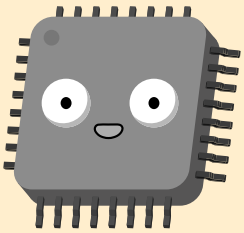
To follow a line track, they need to use their InfraRed sensors. Do you remember? They are still damaged from the crash. Can you help them to fix it?

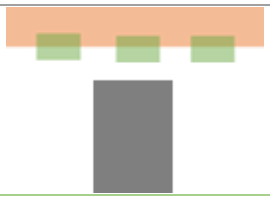
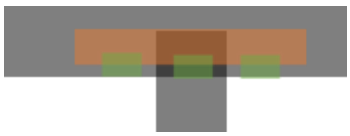
For that, you will need to have a track to test the sensors.

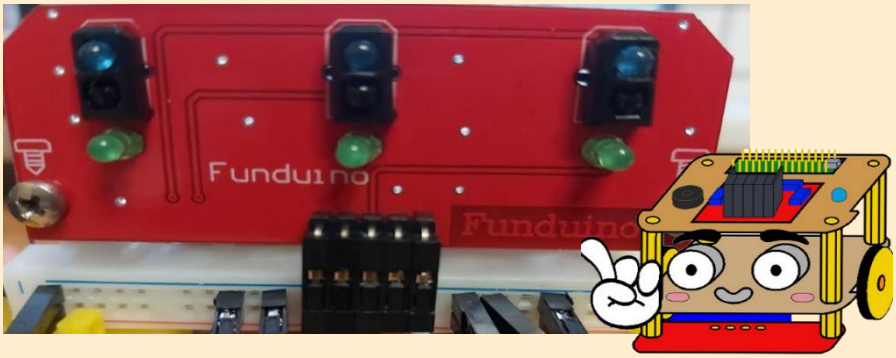


Scan the QR code or click HERE download this track in A3 paper format.

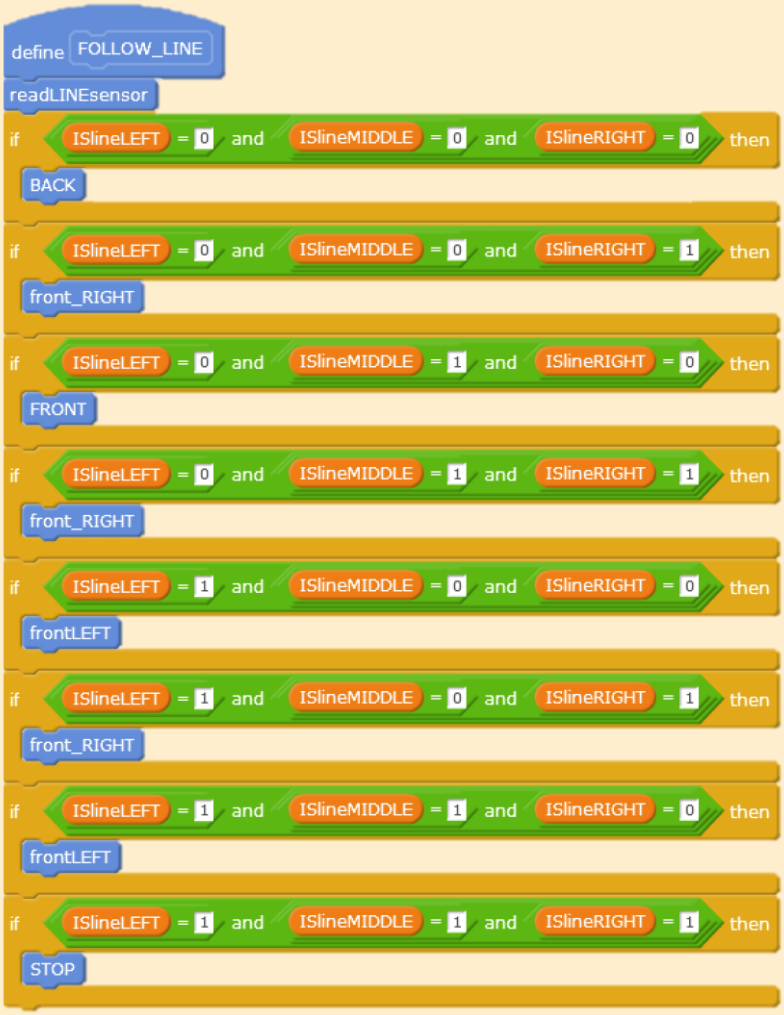
How to follow a line?
With the 3 IR sensors that Stemie and Stemia have, there are only $2^3 = 8$ possible arrangements of the sensors in relation to the line.
Let me summarize….



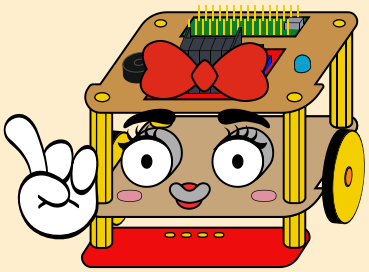
SENSOR POSITION	LEFT SENSOR	MIDDLE SENSOR	RIGHT SENSOR	ACTION
	0	0	0	DEPENDS ON THE PROBLEM
	0	0	1	RIGHT
	0	1	0	FORWARD
	1	0	0	LEFT
	0	0	0	REVERSE
	0	1	1	A LITTLE TO THE RIGHT
	1	0	0	A LITTLE TO THE LEFT
	1	1	1	DEPENDS ON THE PROBLEM

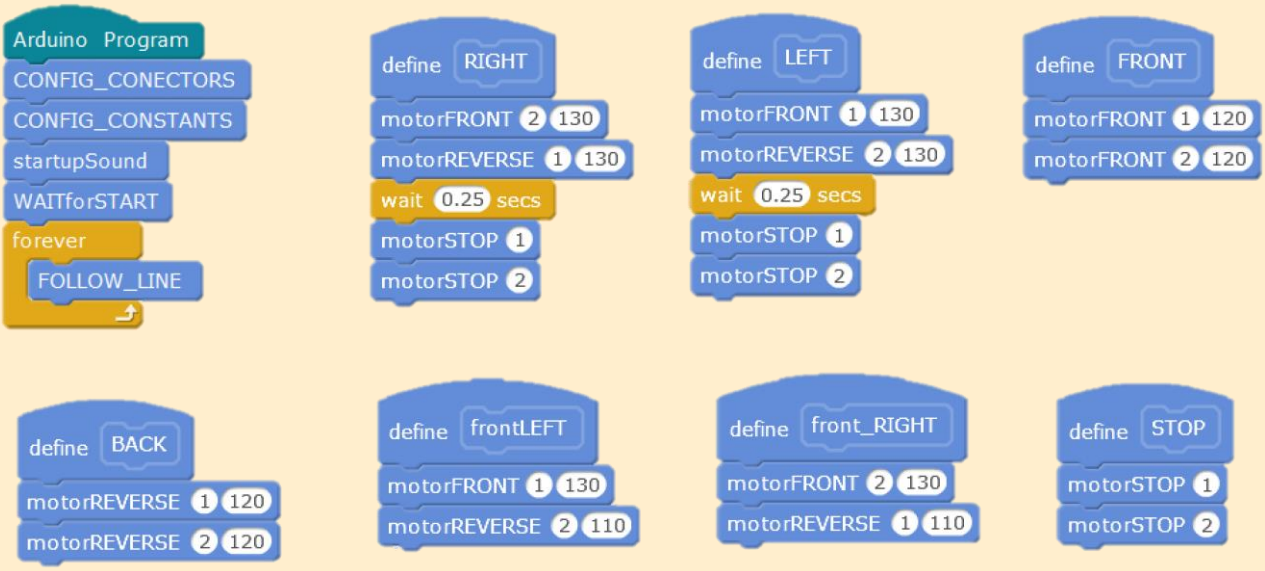


1. Now you have to write a Procedure to follow the line. It may be similar to this example.

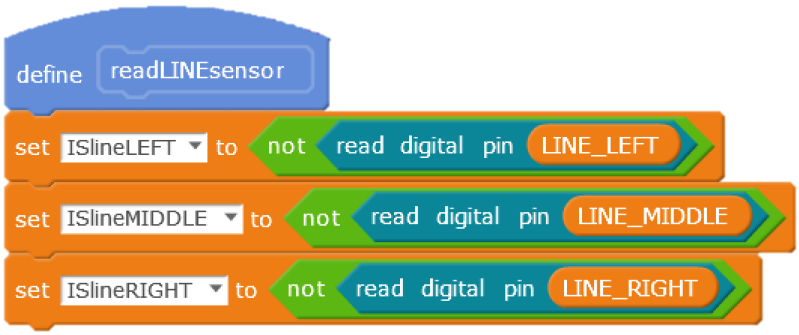


Don't forget to write all the other Procedures and the main program as well. The speeds and wait times may have to be adjusted.

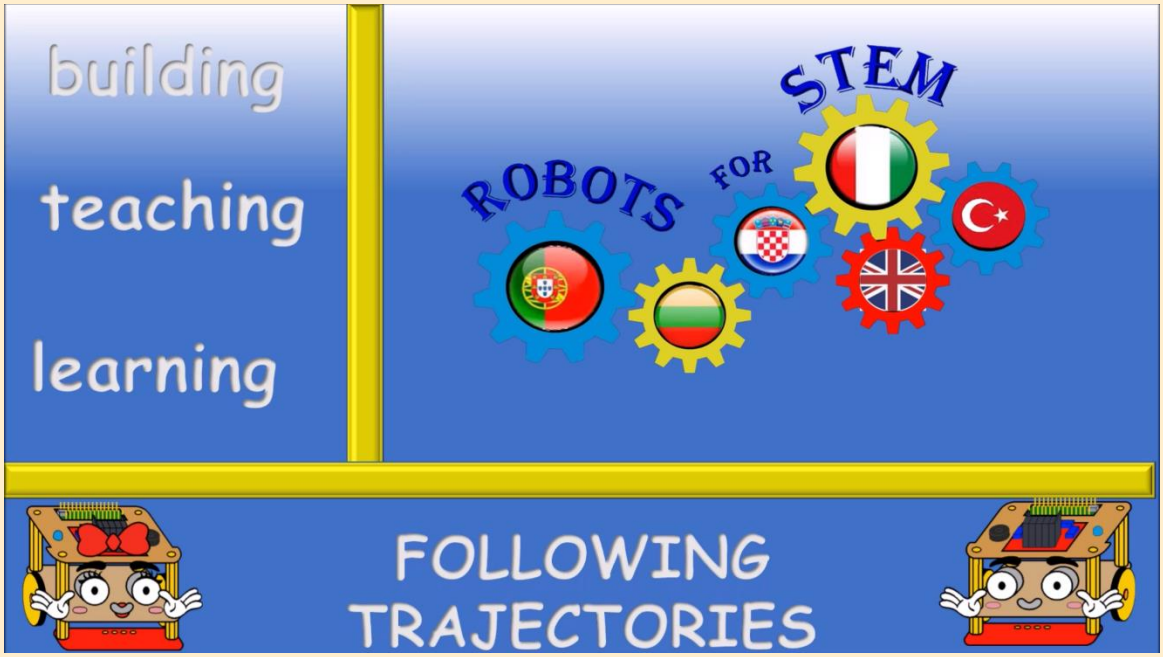




NOTE: There is some information that Stemie and Stemia already have to allow them to follow the line. If you look deep into their program you will find the following procedure... Try to understand it or ask your teacher to explain.

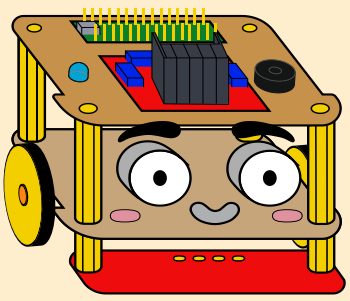


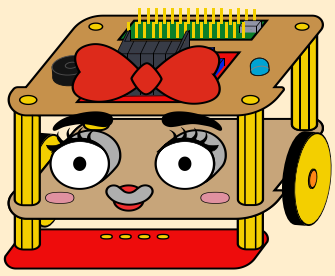
2. **Use black sticky tape to cover an irregularly shaped road and go around it following the line.**



Did you know that lane tracking in today's cars prevents the driver from drifting out of the lane. The driver is warned by an audible signal or steering wheel vibration?

Yes! And I also know that robots help people in logistics warehouses by following the line. They find, scan, bring and take goods to the exact places.

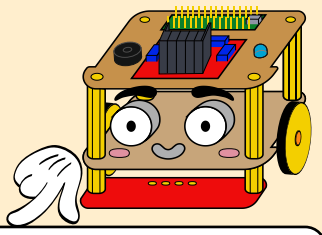




I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Program the robot follow the line			
Where can these ideas be applied in real word?			

CHALLENGE

10 Avoiding obstacles



Please charge my batteries regularly so I can work at my best.

GOALS: I can program the robot to detect the object and avoid it in two different ways.

The first time Stemia and Stemie passed throught the asteroid field near Jupiter, they suffered massive damage on their spaceship and themselves. They are revisiting plans and Jupiter is on them but they face the problem that, again, they have to cross the asteroid ring. They know that a collision with an asteroid can be very dangerous but now they are equipped with sensors that allows them to see the obstacles and to bypass them. The only problem is that they don't know how to used them...

INFO: An asteroid is a small body of the Solar system, up to 1000 km, orbiting the Sun. Most known asteroids (90-95%) are found in the asteroid ring between Mars and Jupiter. They revolve around the Sun in 3-6 years. There are several gaps in the ring, unevenly distributed, and in some places their clusters are visible. About 15,000 asteroids are known in the solar system.

Scan the QR code or click HERE to find out what the asteroid ring looks like and how it was formed.

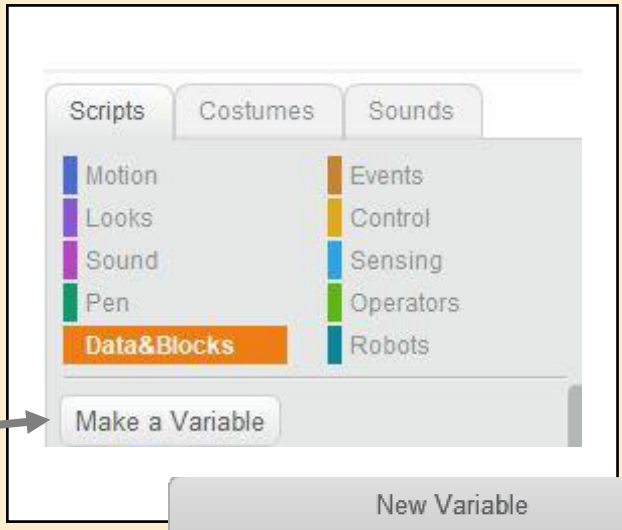
The Ultrasonic Sensor for obstacle detection and distance measurement will help you with the important task.

Can you teach Stemie and Stemia how to work with the Ultrasonic Sensor?

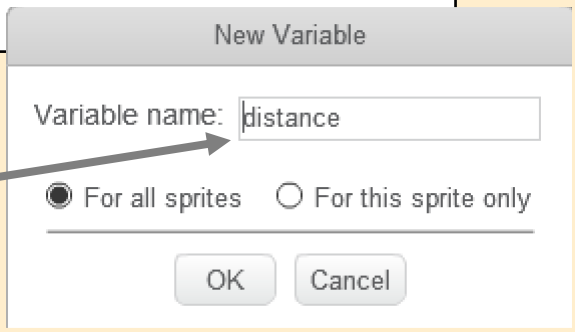
1. **First, create a variable.**

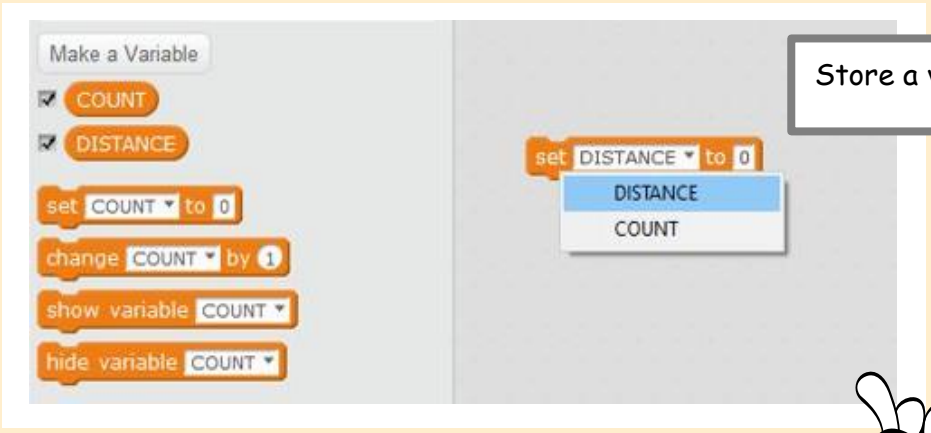
INFO: In computer programming variables are used to store information that can be used later in our program. They are very important in programming. Data like Distance to an object, information on whether the is a line or not and speed can be stored in variables. Others like Age, sex, country, date of birth, eye colour are also examples of variables in other contexts.

Variables can be created in the **Make a Variable** button in the **Data&Blocks** group of blocks.

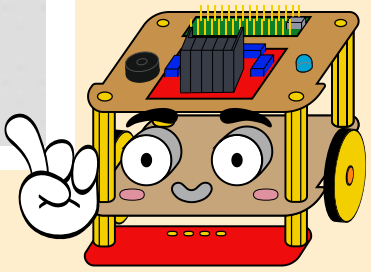


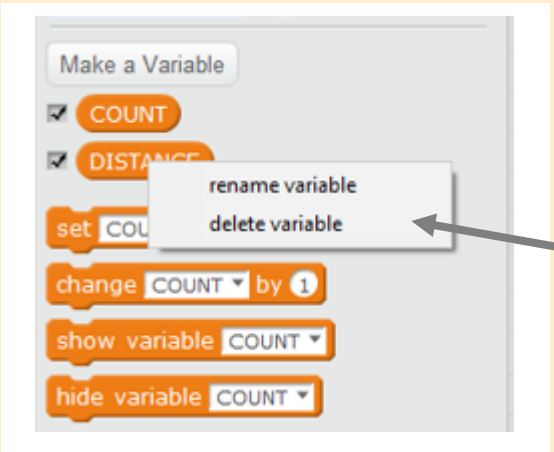
Then, write the name of the Variable.



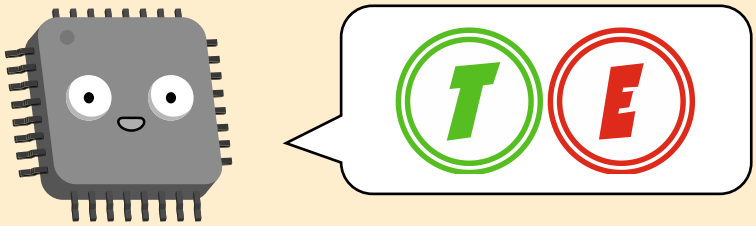


Store a value in a Variable

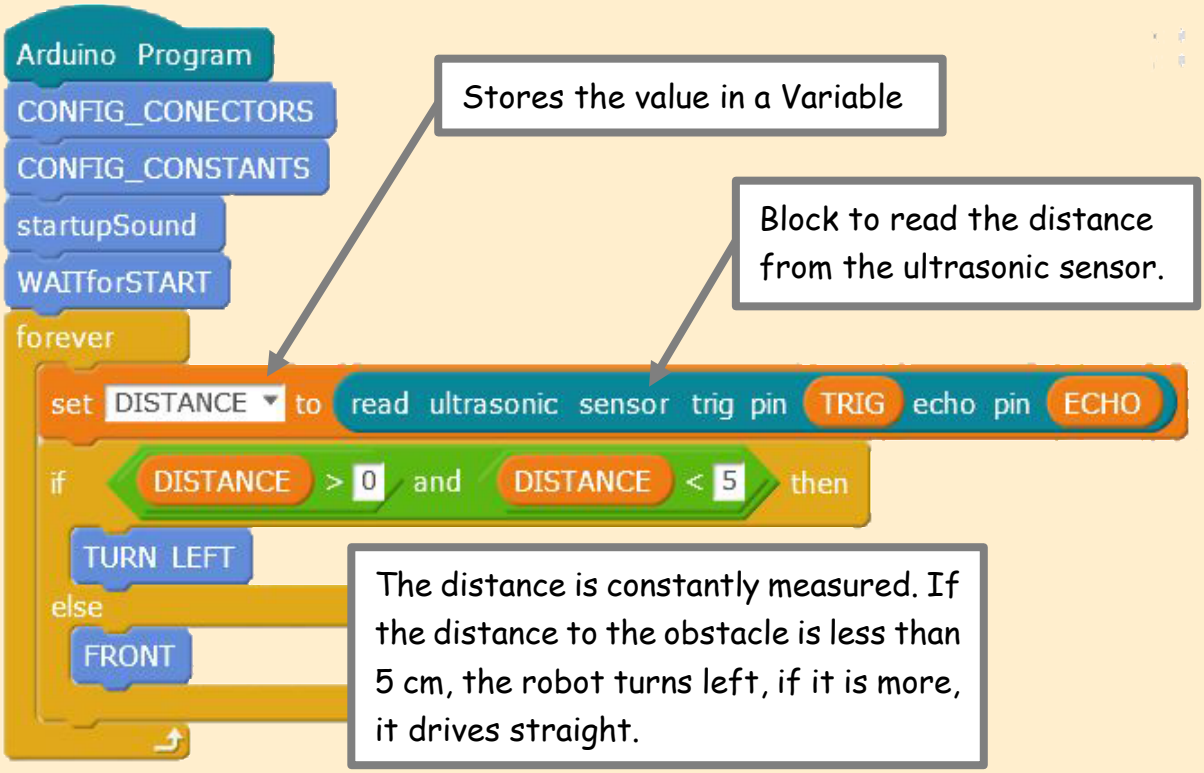




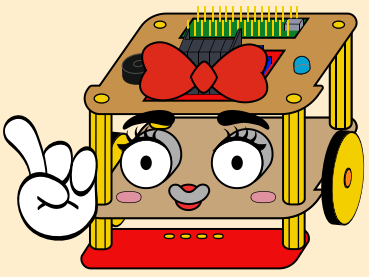
You can rename or delete a Variable by right clicking the Variable`s name and choosing the desired option.

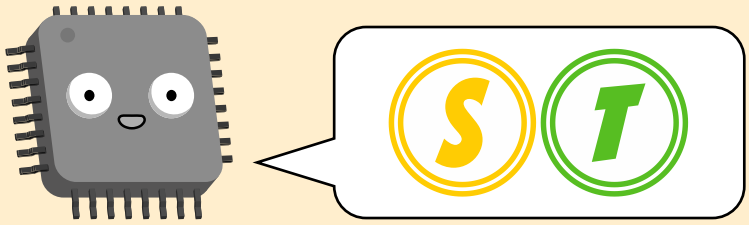


2. **Once you have prepared the variable, you can write the program.**

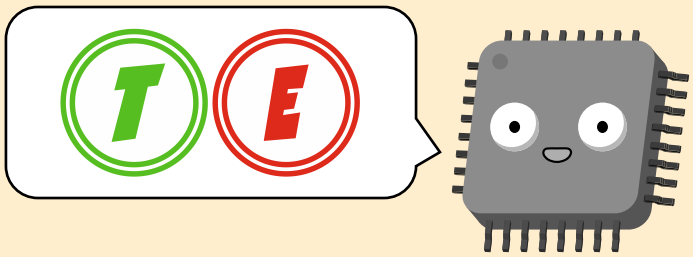


Don't forget that for the program to work, you still need to write the TURN LEFT and FRONT procedures.

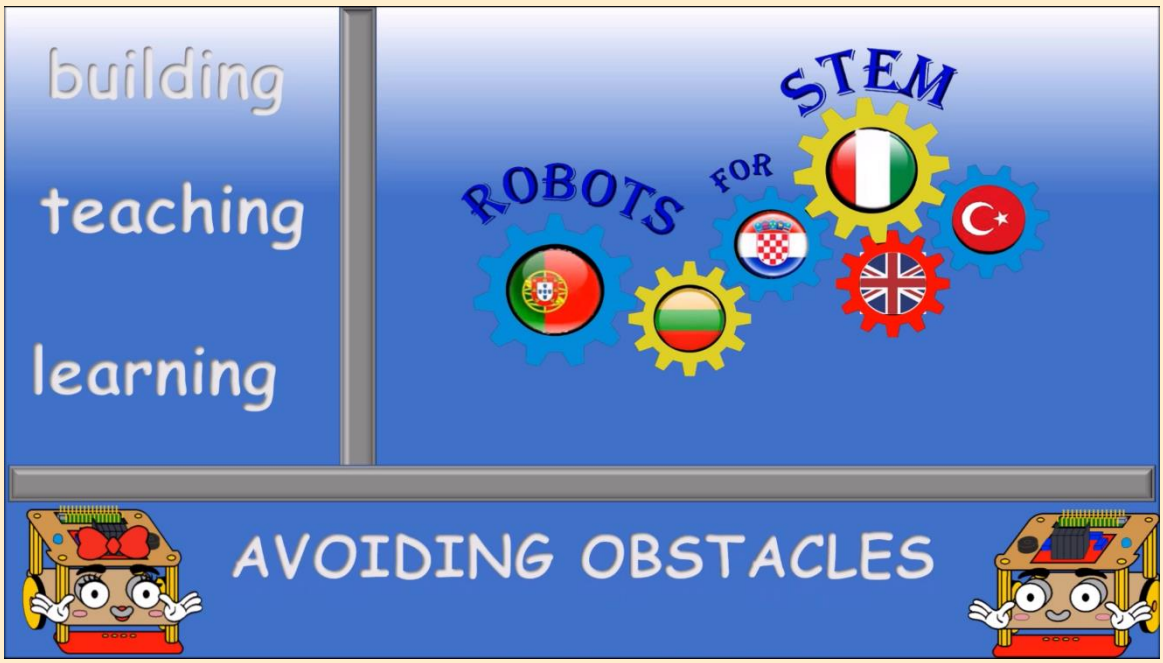


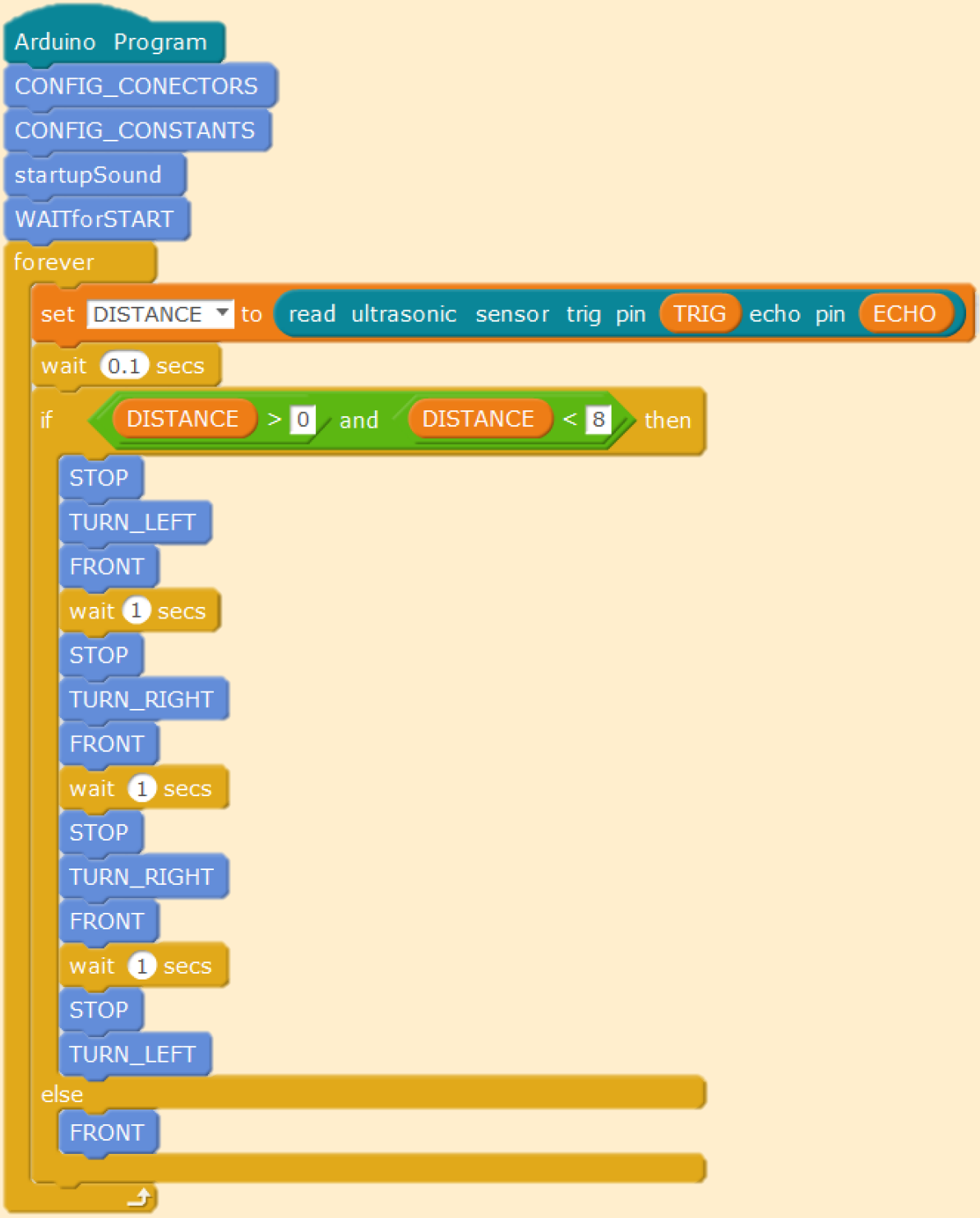


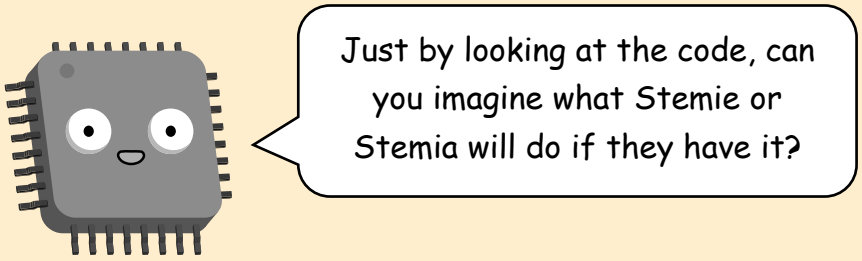
3. **Improve the program so that when the robot moves straight, the green light is on but while it turns, the red light shines.**



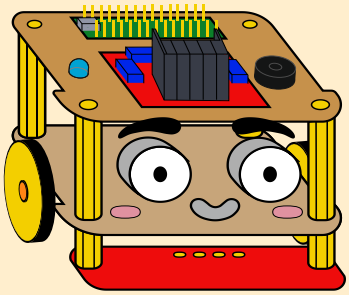
4. **Program the robot with the following procedures. Let the robot go towards the object, watch it and draw the trajectory on a sheet of paper.** Watch the video for inspiration!



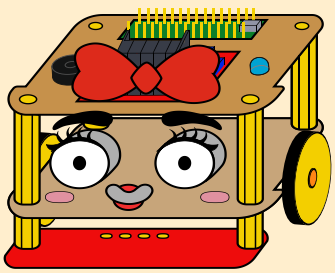




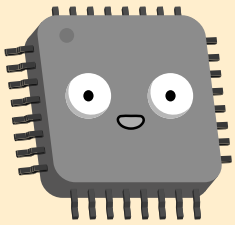
Do you know that about 65 million years ago the dinosaurs and some other animals disappeared after an asteroid hit Earth?



To prevent this from happening, Nasa scientists are now experimenting with whether it is possible to change the direction of the asteroid. In September 2022, a 610 kg spacecraft crashed into an asteroid at a speed of 24,000 km/h. Take a look HERE.



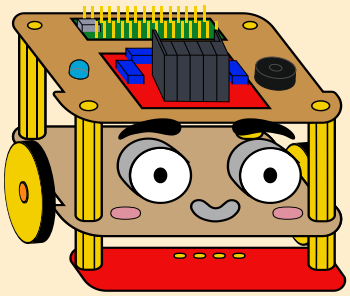
I can:	NOT YET	MORE OR LESS	YES, COMPLETELY
Program the robot to detect the object and avoid it turnig to one side			
Program the robot to detect the object and avoid it going around			
Where can these ideas be applied in real word?			



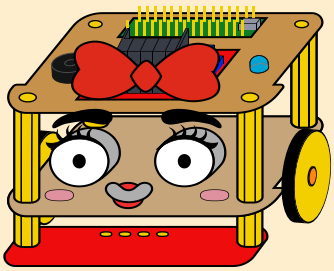
Hi! It's me again!

Thanks to your help, Stemie and Stemia are now 100% functional.

Thank you, master robot programmer.



After some great adventures it's time to go home...We will see you next time.



ROBOTS FOR STEM, 2023

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