

Silly Walks

Build a robot that moves forwards – without using wheels!



Think Like an Engineer:

How can you propel your robot forward without wheels?

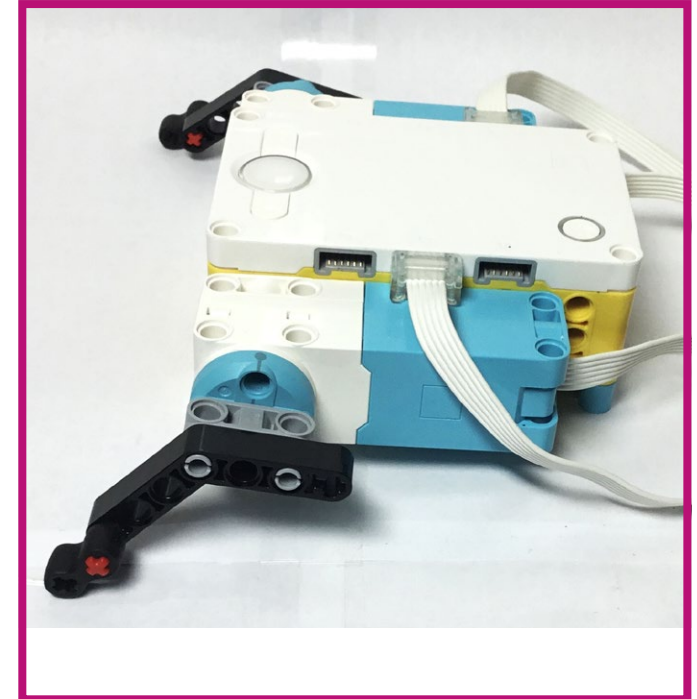
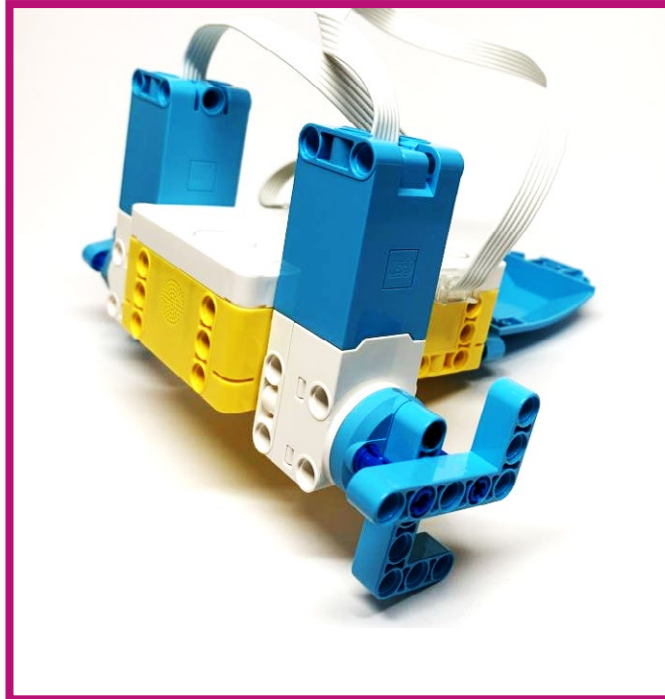
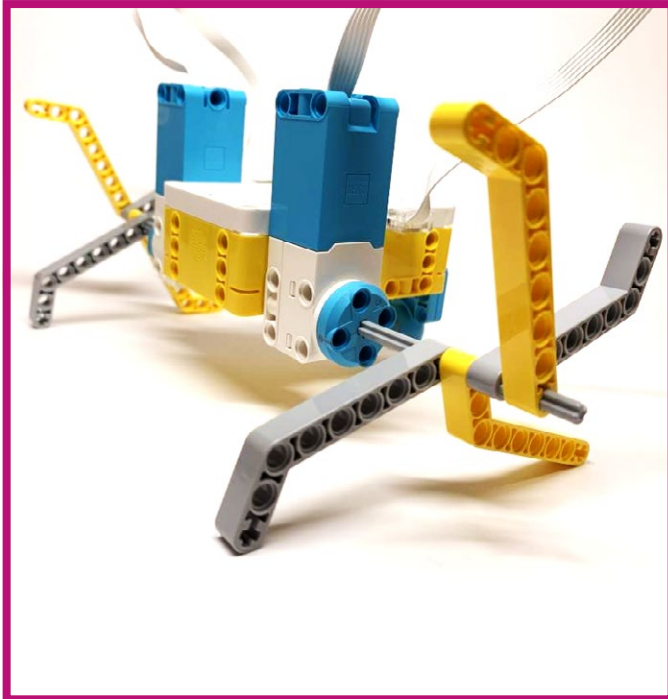
Think Like a Physicist:

How will the length of your robot's legs affect its motion?



Example Ideas

What are different ways you can attach the "legs" to the motor?



Flip over for more details!

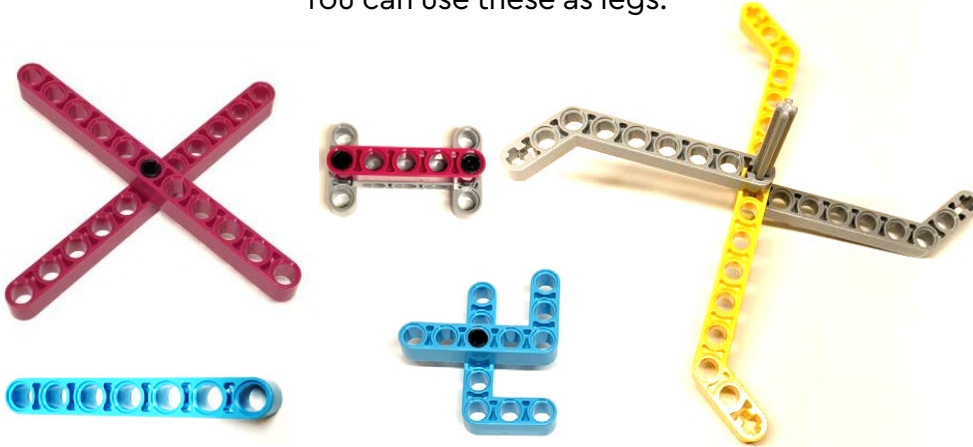




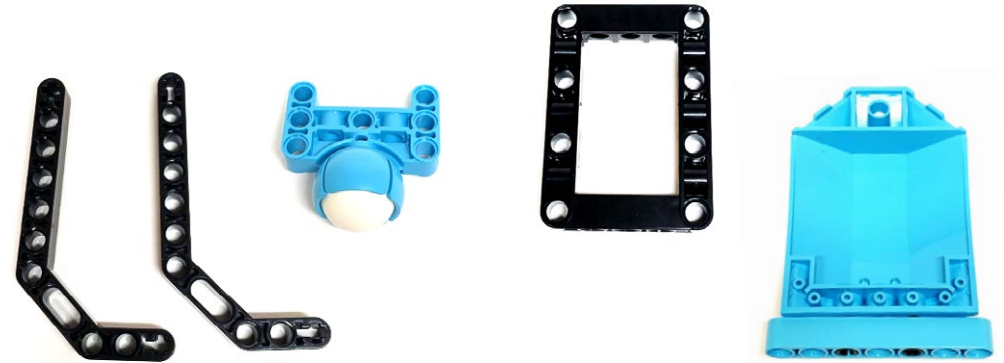
Build It!

LEGO® pieces are versatile! Be creative about what pieces you use and don't be afraid to think outside the box!

You can use these as legs:



You can use these as stabilizers or supports:



Code It!

Try making your robot stop in between rotations
How fast do you want your robot to move?

```
1 from hub import port
2 import runloop, motor_pair, time
3
4 motor_pair.unpair(motor_pair.PAIR_1)
5 motor_pair.pair(motor_pair.PAIR_1, port.A, port.B)
6
7 async def main():
8     for i in range(10):
9         await motor_pair.move_for_degrees(motor_pair.PAIR_1, 100, 0, velocity=500)
10        time.sleep_ms(1000)
11
12 runloop.run(main())
```

Try to Modify It:

- Use a sensor to keep your robot from hitting a wall
- Do you want your motors to move together or alternate?



Challenge Yourself!

Try to build a silly walks robot with only one motor.

Greetings, Earthling

Build a robot that greets people with a wave, a fist bump, a high-five or some other welcoming movement!



Think Like an Engineer:

How can you position a motor so that the arm moves in a more natural way?

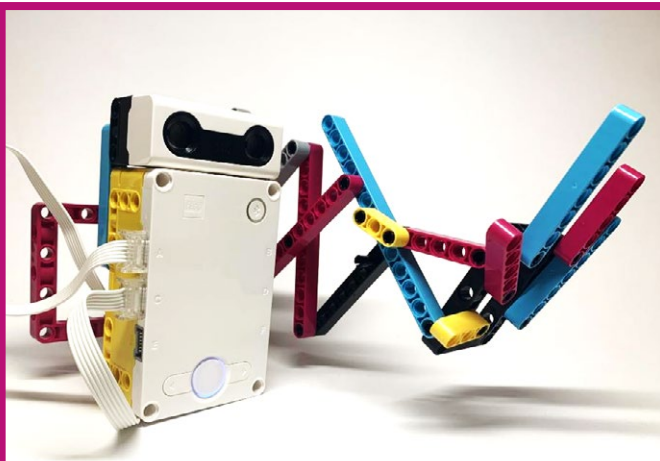
Think Like an Artist:

How can you make the robot look more friendly and approachable?



Example Ideas

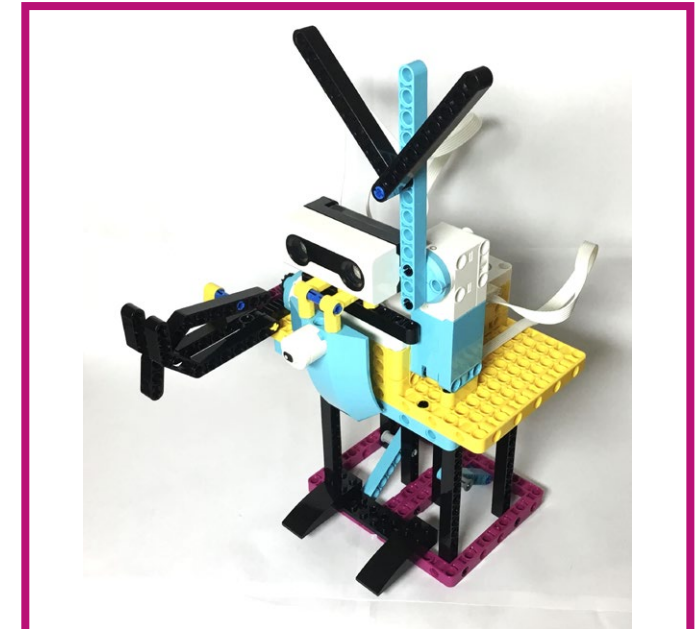
How do you want your robot to greet you?



A High-Fiving Robot



A Waving Robot



A Fist-Bumping Robot

Flip over for more details!



Beginner



All Skills

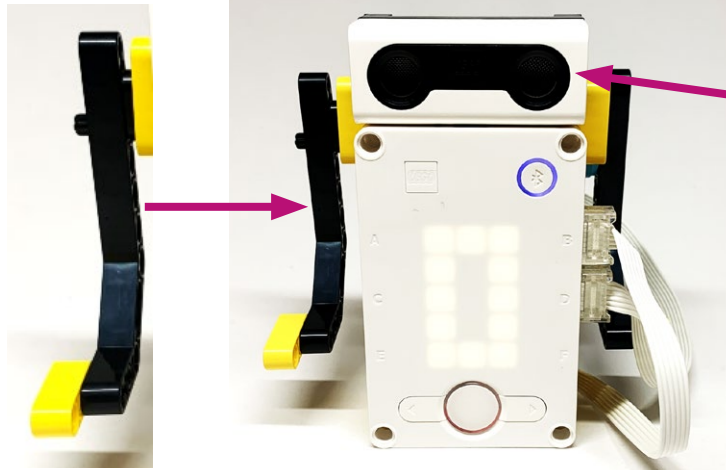


Mechanics & Movements



Build It!

What elements do you want to add to the robot?



You can add a piece at the end of the arm to act as a hand.



The ultrasonic sensor looks like eyes and can automate movement.



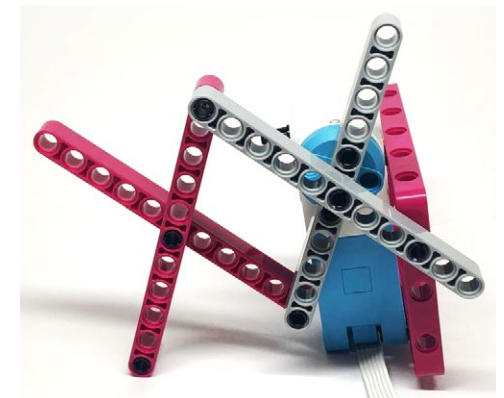
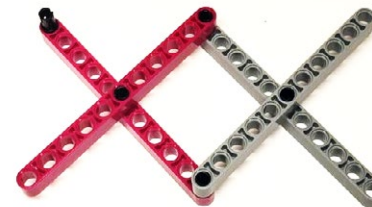
This hand looks realistic with "fingers."

Code It!



Think about how much you want the robot to move. Do you want to measure by time or rotations?

```
1 from hub import port
2 import runloop, motor
3
4 async def main():
5     for i in range(10):
6         await motor.run_for_degrees(port.A, 180, 500)
7         await motor.run_for_degrees(port.A, -180, 500)
8
9 runloop.run(main())
```



You can connect "X" shaped pieces to make an extendable arm.



Challenge Yourself!

Try to use an ultrasonic sensor to have the robot only move when someone is in front of it.

Puppet Show

Create any sort of puppet that moves using the SPIKE™ Prime.



Think Like an Engineer:

How will you test and improve your initial puppet to be better?

Think Like a Biologist:

What kind of creatures can you make and how would they move?

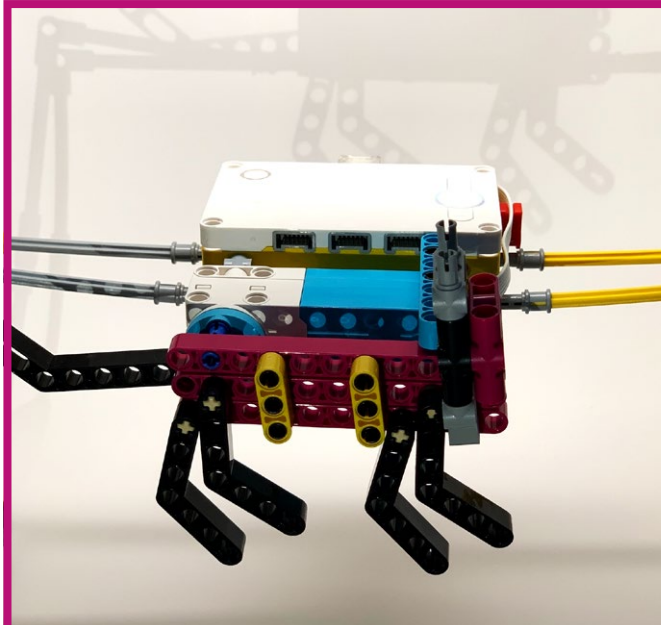


Example Ideas

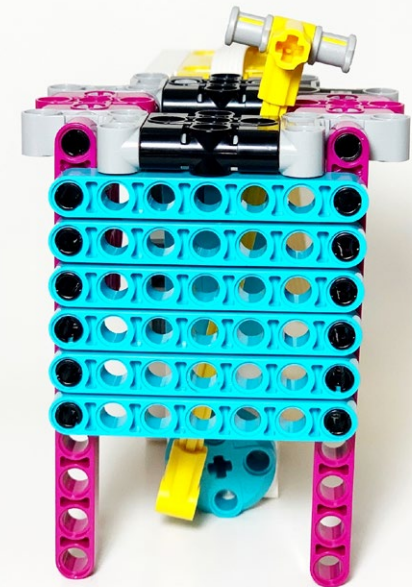
Below are a few different types of puppets, can you think of more?



String Puppet of a Person



Shadow Puppet of a cat



Rod Puppet of a snake in a basket

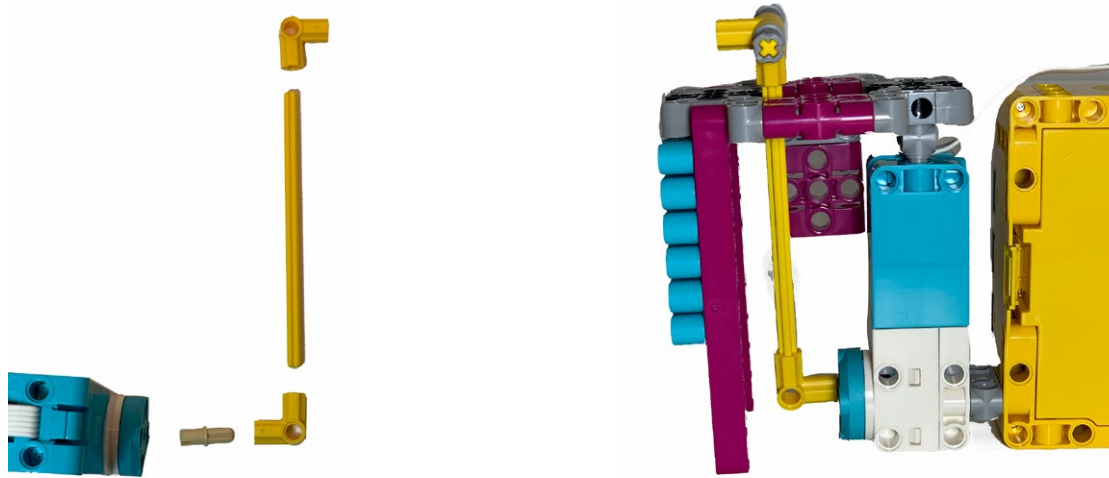
Flip over for more details!





Build It!

Think about how you could transform rotational motion into linear motion.
Try to make your favorite animal!



Code It!

Code for the rod puppet:

```
1 from hub import port
2 import runloop, motor
3
4 async def main():
5     count = 0
6
7     while count < 10:
8         await motor.run_for_time(port.D, 500, -300)
9         await motor.run_for_time(port.D, 1000, 300)
10        await motor.run_for_time(port.D, 1000, 300)
11
12        count += 1
13
14 runloop.run(main())
```

Modify It:

- Can you make your puppet do different movements when different buttons are pressed?
- Can you have noise and movement at the same time?
- Can you add for and while loops in your own code?



Challenge Yourself!

Can you make a puppet that moves to music?

Garden

How does your garden grow? Show us what's in your garden—a blooming blossom, a vigorous vegetable, a robotic rake?



Think Like a Gardener:

What kinds of living plants or inanimate objects can be found in a garden?

Think Like an Engineer:

How can you use multiple motors to add movement to your garden?



Example Ideas



Flourishing Flowers



A Blissful Birdhouse



A Bewitching Butterfly

Flip over for more details!



Beginner



All Skills



Nature & Animals



Build It!

Take inspiration from the shapes of the pieces to build a realistic plant or object!



← The petals of the sunflower are formed with straight and angled yellow pieces. →



Code It!

Code for the butterfly's antennae:

```
1 from hub import port
2 import runloop, motor
3
4 async def main():
5     initial_power = 100
6     rotation = 0.5
7     for i in range(10):
8         await motor.run_for_degrees(port.A, int(rotation * 360), initial_power)
9         await motor.run_for_degrees(port.A, int(rotation * -360), initial_power)
10
11 runloop.run(main())
```

Modify It:

- Each build is unique and needs different values for the rotation of the motor.
- Setting different motor speeds (at the start or throughout your code) can allow your plant or object to be more dynamic.
- Change the light pattern on your brick!



Challenge Yourself!

Can you use a sensor to activate the movement of your garden object?

Simple SPIKE™ Car

Build a sturdy car using as few pieces as possible. Your robot needs to be able to drive forward for two seconds, backwards for two seconds, spin right for 2 seconds, and spin left for 2 seconds.



Think Like an Engineer:

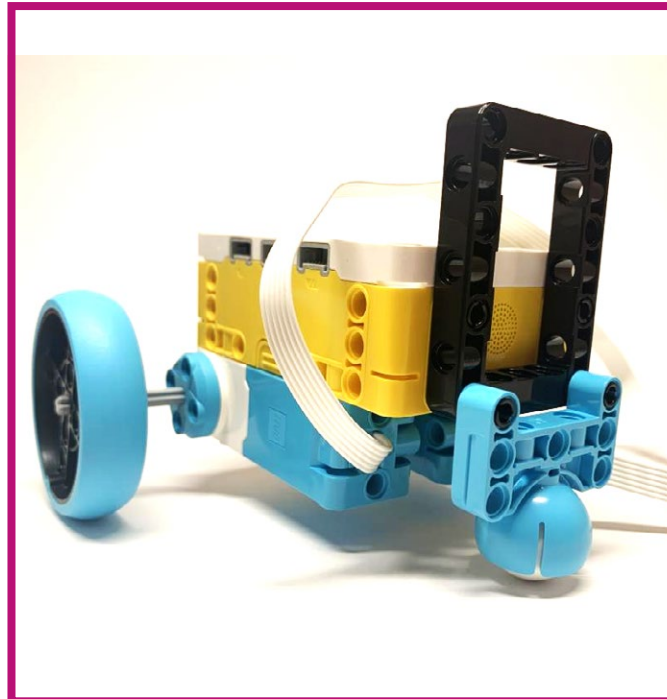
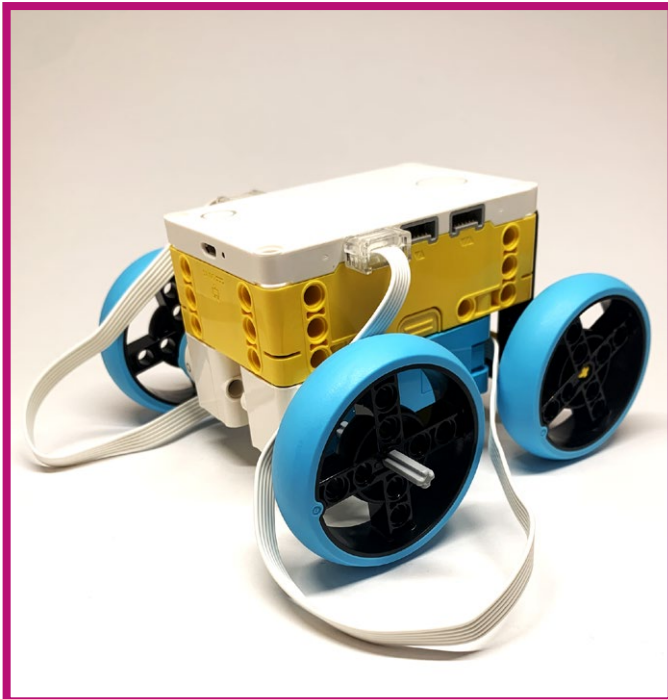
Feel free to experiment with your robot to see what works!

Think Like an Architect:

Can a group of pieces be replaced by fewer pieces?

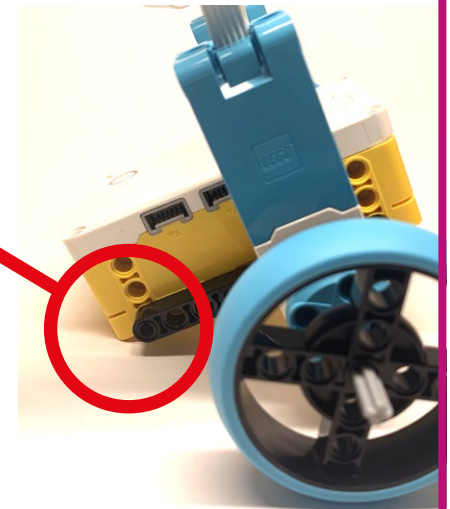


Example Ideas



Balance it
Make sure your robot is balanced and only the wheels are touching the ground.

Don't
do this



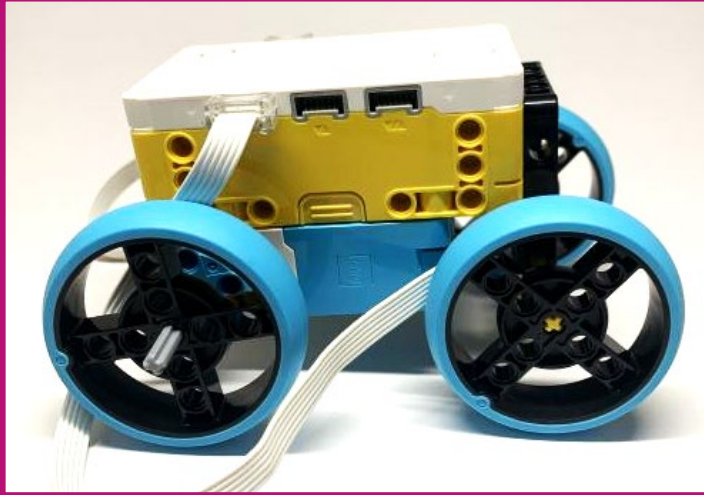
Flip over for more details!



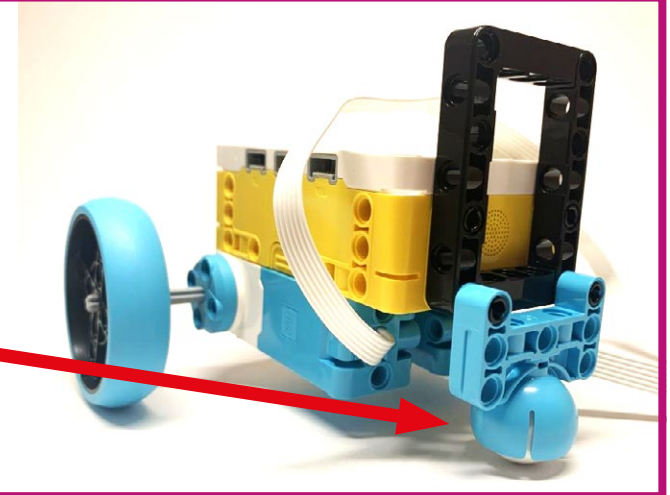


Build It!

What different structures of cars can you make?



This caster wheel is helpful because it can turn in any direction!



Code It!

This is the code for two motors going forward.

```
1 from hub import port
2 import runloop, motor_pair
3
4 motor_pair.unpair(motor_pair.PAIR_1)
5 motor_pair.pair(motor_pair.PAIR_1, port.A, port.B)
6
7 async def main():
8     await motor_pair.move_tank_for_time(motor_pair.PAIR_1, 500, 500, 2000)
9
10 runloop.run(main())
```

Try to Modify it

How can you modify this so your robot can go backwards and turn?



Challenge Yourself!

Make the robot draw a figure eight!

Percussion Playtime

Clash clang boom bang! Create a percussion instrument for a band. Drums, cymbals, xylophone, bells—any type of percussion instrument is welcome.



Think Like an Engineer:

How will you improve your design to make an even louder sound.

Think Like a Musician:

How does the shape of a the instrument affect the sounds?



Example Ideas

Test out attachments other than motors to make noises!



Maraca



Drum



Xylophone

Flip over for more details!





Build It!

Try starting by making a straightforward build (like a box) then add on to it in order to make something more complex (like filling it with legos parts to make a maraca).

Keep in mind there are so many ways to make even a simple design like a box!



Code It!

Code for the the color sensor to have the xylophone play different notes.



```

1 from hub import port, sound
2 import runloop, color_sensor, color
3
4 async def main():
5     while True:
6         colorSeen = color_sensor.color(port.E)
7
8         if colorSeen == color.BLACK:
9             await sound.beep(800, 500, 50)
10
11        if colorSeen == color.AZURE:
12            await sound.beep(1200, 500, 50)
13
14        if colorSeen == color.YELLOW:
15            await sound.beep(1400, 500, 50)
16
17 runloop.run(main())

```

Think about it!

- It's important to put comments in your code so other people can understand it.
- Can you make each note play for a specified time?
- What notes (do, re, mi, etc.) do these beeps correspond to?



Challenge Yourself!

Beats are fun to sing along to but can you make an instrument that plays a specific song?

Space Exploration

Blast off on a space adventure! Create a rocket ship, a tool for a space traveler, or even an alien being—there are no limits to this cosmic journey.



Think Like an Inventor:

What tools would be most helpful if you had to go to space?

Think Like an Explorer:

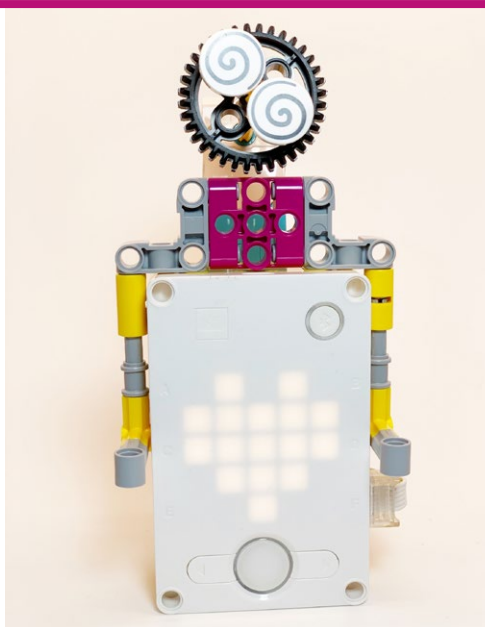
What creatures or types of nature could you find on different planets?



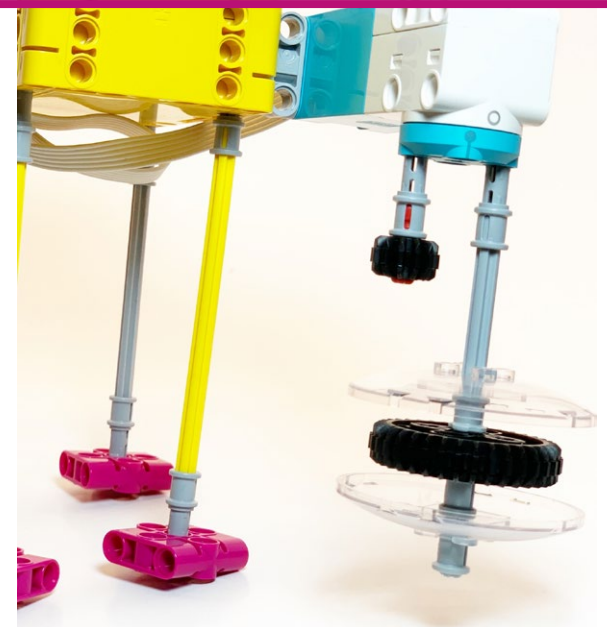
Example Ideas



Rocket Ship Taking Off



Alien With Spinning Head



Orbiting Planets

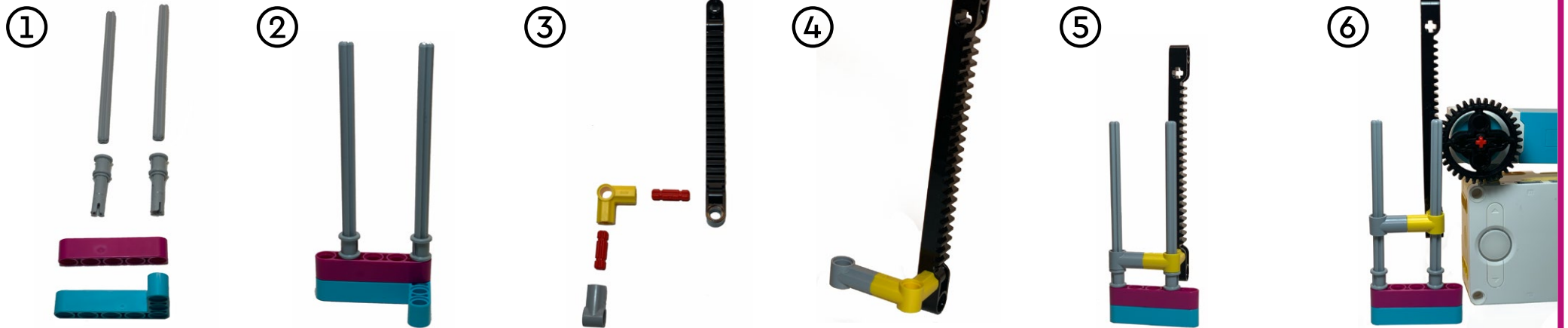
Flip over for more details!





Build It!

A rack (the linear gear) and pinion (the circular gear) can turn a motor's rotating motion into linear motion (like in the rocket ship example). The pinion rolls along the rack like a wheel, moving the rack back and forth or up and down.



Here is an example base that makes the rack move up and down smoothly.



Code It!

Code for the Rocket:

```
1 from hub import button, port, light_matrix
2 import runloop, motor
3
4 async def main():
5     while True:
6         if button.pressed(button.LEFT):
7             light_matrix.write("Blast Off!", 100, 250)
8             await motor.run_for_degrees(port.A, -90, 100)
9
10 runloop.run(main())
```

Modify It!

- Can you make space noises with the hub?
- Can you add more For and While loops in your code in order to have your robot working for longer?



Challenge Yourself!

Can you incorporate a sensor into your design?

Proverbial SPIKE™ Prime

The early bird catches the worm. Don't put all your eggs in one basket. Make a proverb come to life using SPIKE Prime. Choose a familiar favorite or a proverb from another part of the world.



Think Like an Engineer:

How can you include movement, with a motor or gears, to help illustrate your proverb?

Think Like a Writer:

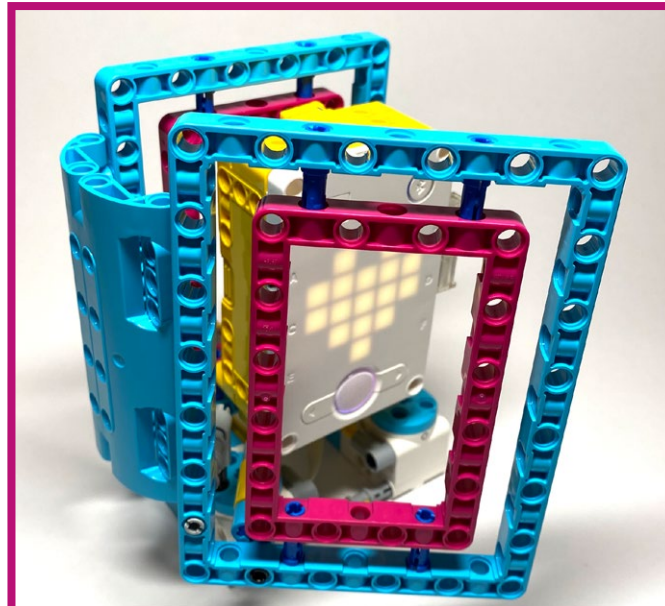
What proverb could you apply to an experience you had in your own life?



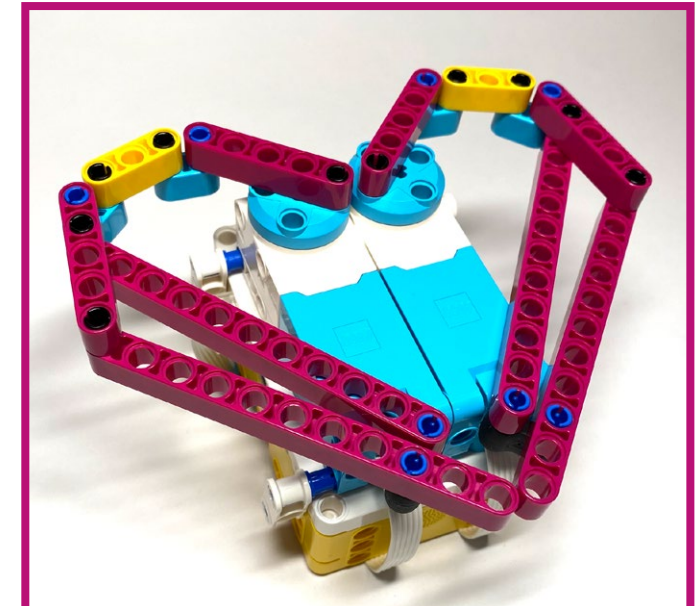
Example Ideas



The early bird catches the worm.
(United States)



Don't judge a book by its cover.
(United States)



The heart that sighs has not what it desires.
(France)

Flip over for more details!



Beginner



All Skills

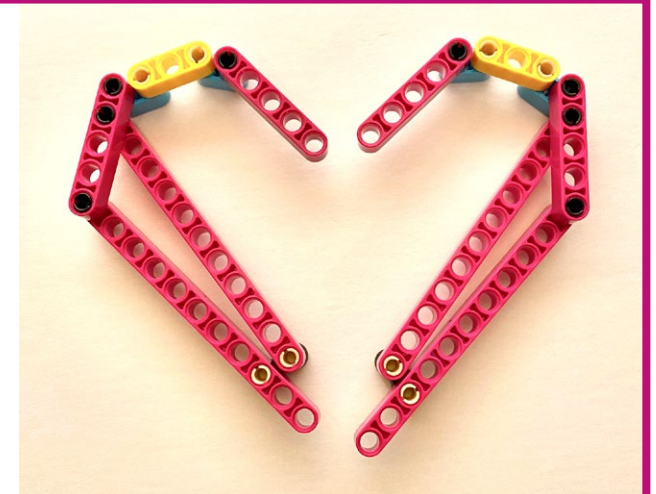


Art & Literature



Build It!

Look at the shapes of your pieces ahead of time to see what you can use to illustrate your proverb!



Code It!

Code for the book opening and closing:

```
1 from hub import port, light_matrix
2 import runloop, motor
3
4 async def main():
5     for i in range(10):
6         light_matrix.show_image(3)
7         await runloop.sleep_ms(2000)
8
9         await motor.run_for_degrees(port.A, int(0.15 * 360), 100)
10
11        light_matrix.show_image(1)
12        await runloop.sleep_ms(2000)
13
14        await motor.run_for_degrees(port.A, int(-0.15 * 360), 100)
15        light_matrix.show_image(3)
16
17 runloop.run(main())
```

Modify It!

- How can you use the built-in lights on your Hub to illustrate your proverb?
- Can you use a loop ("repeat") or a conditional statement ("if-then") in your code? Can you use multiple loops?



Challenge Yourself!

Can you make your SPIKE™ Prime Proverb interactive with the user?

Clean Sweep

As all LEGO® fans know, pieces of plastic tend to end up on the floor! Create a sweeper to clear the floor of LEGO bricks or other small LEGO pieces. Any type of device is fine – broom, plow, vacuum – as long as it gets the floor clean.



Think Like an Engineer:

How can you improve your device to clean larger/smaller surfaces?

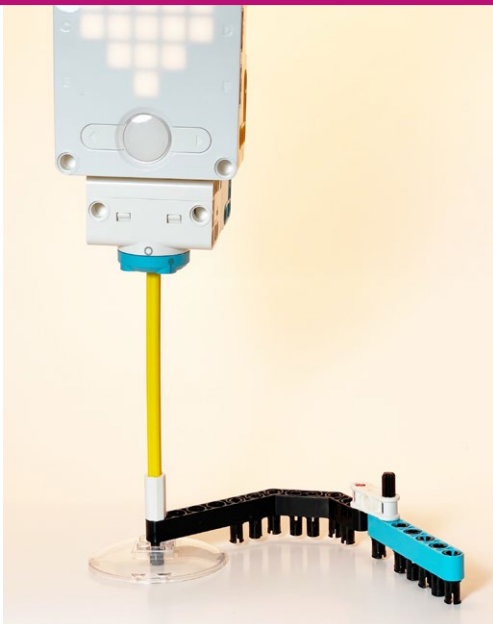
Think Like an Entrepreneur:

Can you make a device that LEGO fans might want to own?

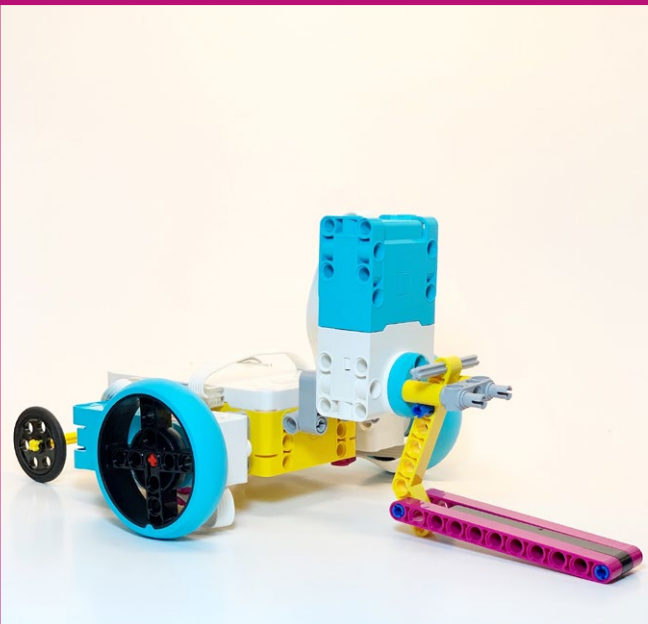


Example Ideas

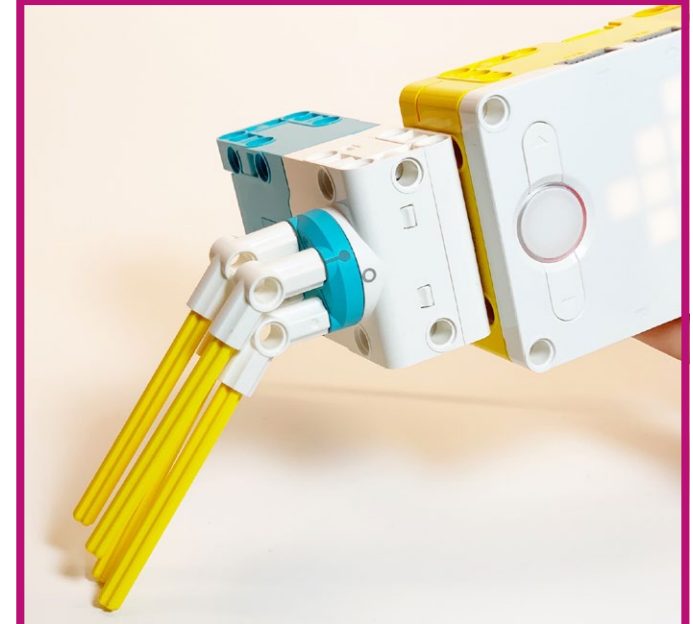
Is your device going to be hand-held or will it move on its own?



Circular Broom



Self-Moving Sweeper



Motorized Broom

Flip over for more details!



Build It!

It's important to make sure your robot is stable.

Try making a steady center point or a fulcrum for the rest of your robot to move around.

①



②



③



Code It!

Code for the Motorized Broom:



```
1 from hub import port, light_matrix
2 import runloop, motor
3
4 async def main():
5     await light_matrix.write("Beginning to Clean!", 100, 500)
6
7     while True:
8         await motor.run_for_time(port.A, 2000, 100)
9         await motor.run_for_time(port.A, 2000, -100)
10        await light_matrix.write("Still Cleaning!", 100, 500)
11
12 runloop.run(main())
```

Try to Modify It!

- Try to make your robot talk to you as it cleans!
- What effect does the speed of the motor have on the cleaning ability?



Challenge Yourself!

Sweeping away the plastic pieces is great, but can you make a robot that collects the pieces as well?

Ball Throwing

Design a machine to throw a small plastic ball as far as possible.



Think Like an Athlete:

How do you throw a ball? How can you use that to build this robot?

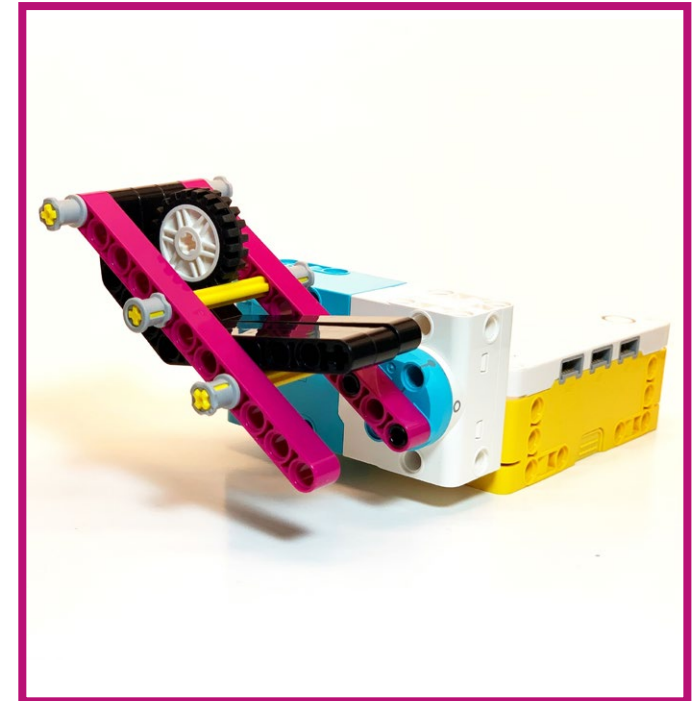
Think Like a Physicist:

How you you use leverage to get you ball to go further?



Example Ideas

Try to mimic real-life machines that throw balls (like a slingshot or a catapult).



Flip over for more details!





Build It!

Here is an example of a build that mimics the human arm with a joint at the "wrist"!



Code It!

Code for the Catapult:

```

1 from hub import port
2 import runloop, motor
3
4 async def main():
5     while True:
6         motor_A = port.A
7         await runloop.sleep_ms(2000)
8         await motor.run_to_absolute_position(port.A, 260, 300, direction=motor.SHORTEST_PATH)
9         await runloop.sleep_ms(1000)
10        await motor.run_for_degrees(motor_A, 72, 300)
11        await motor.run_to_absolute_position(motor_A, 260, 300, direction=motor.SHORTEST_PATH)
12
13 runloop.run(main())

```

Modify It!

- Can you write code that makes it easier for the user to reload the machine?
- What happens if you increase/ decrease the number of rotations or the speed?
- What comments could you add to this code?



Challenge Yourself!

Try to make your robot throw a ball as far as you are tall!