Lesson 6

Careful Drive!

Your robot learns to feel

STEAM · 45 minutes · Beginner

Today mBot2 gets a sense of balance, just like you have.

It will feel tilts, shakes, spins and crashes — and slow down on bumpy ground so it doesn't tip over.

What You Will Be Able To Do Today

1

Recognize and use the gyroscope and accelerometer blocks in CyberPi

2

Explain how these two sensors work and why they team up

3

Build a program that measures how much mBot2 is tilting

4

Make the robot adjust its driving when it detects a crash or a bumpy road

Two Sensors Answer Two Different Questions

- A gyroscope measures tipping and turning — how fast you are rotating
- An accelerometer measures changes in speed
- Each one alone tells only part of the story
- Together they work out the position and movement of cars, robots, even space probes
- On a bumpy road a robot can drive slower so it does not tip over

In short

- Gyroscope = spinning and tipping
- Accelerometer = speeding up and slowing down

Your Phone And Car Airbags Use These Too

- How does a phone know you turned it sideways?
- How does a car decide a crash is bad enough to fire the airbags?
- Sailors struggled for centuries to know their position under cloudy skies

The same answer

Household gadgets, robots and spacecraft all solve it the same way — with at least a gyroscope and an accelerometer.

How Each Sensor Actually Works

Gyroscope

- Uses a crystal held under electric tension
- Tipping force becomes an electrical signal
- Measures rotation speed in degrees per second
- Can estimate angles, but it "drifts" over time and loses accuracy

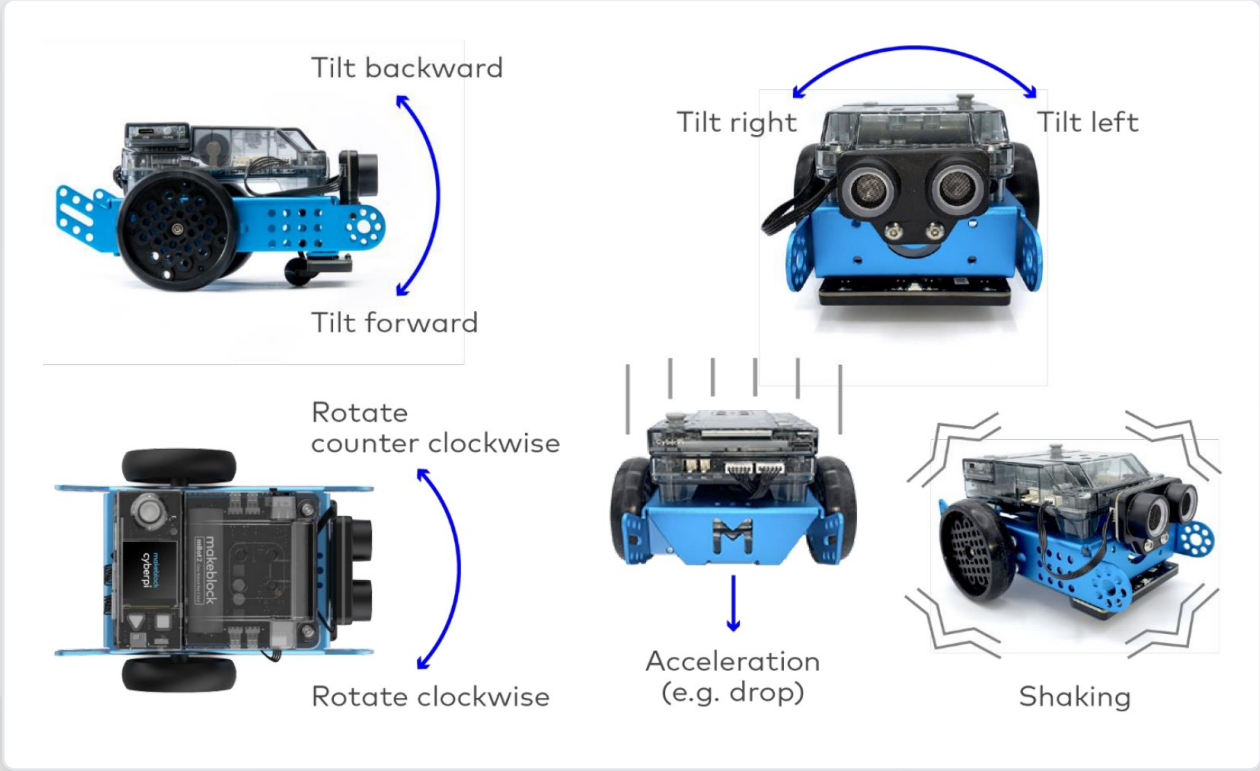
Accelerometer

- Reports change in speed
- Senses gravity's pull compared to free fall

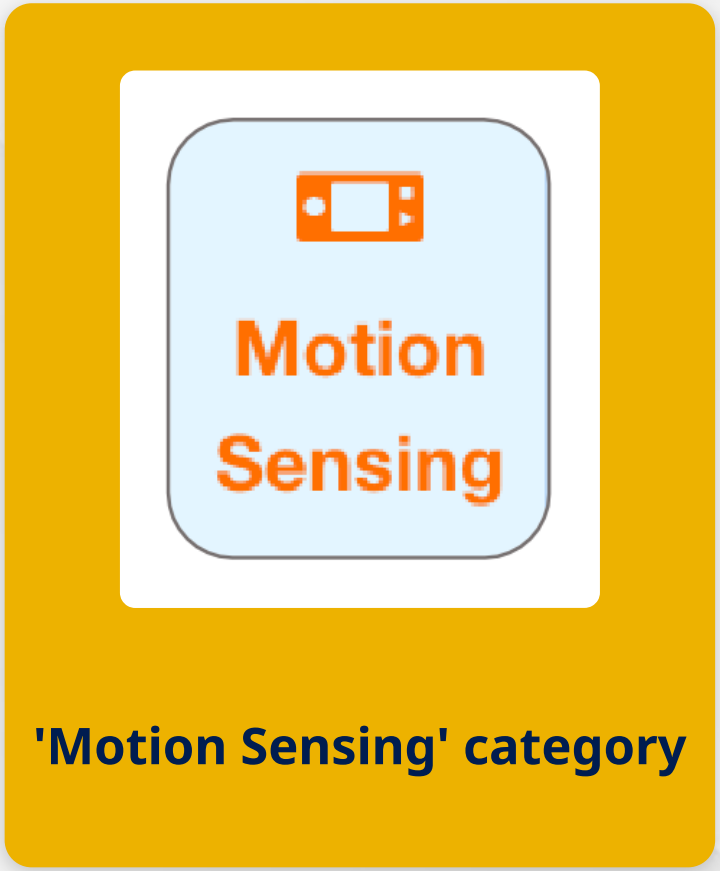
Both sensors measure on three axes: X, Y and Z

Which Movements Can mBot2 Feel?

- Tilt forward and tilt backward
- Tilt left and tilt right
- Rotate clockwise and counter clockwise
- Acceleration, such as being dropped
- Shaking
- Both sensors sit on one small chip on the CyberPi, so we call it the motion sensor



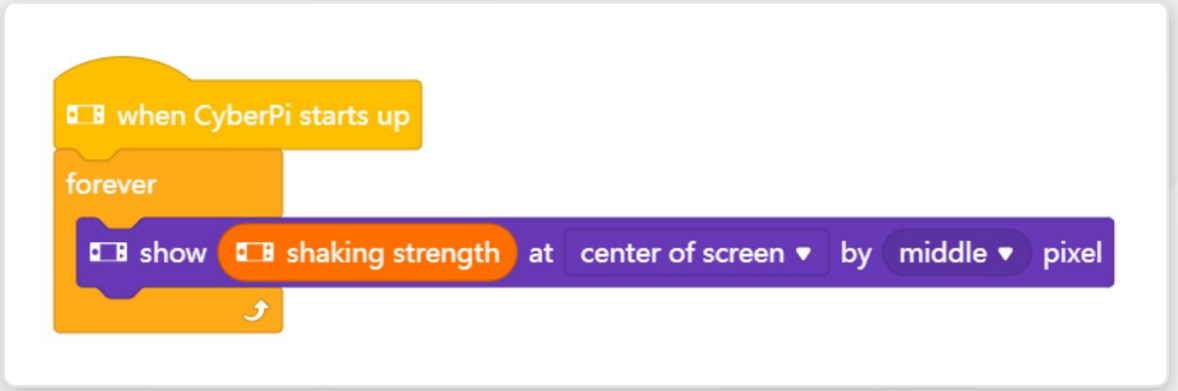
The Orange Motion Sensing Blocks



'Motion Sensing' category

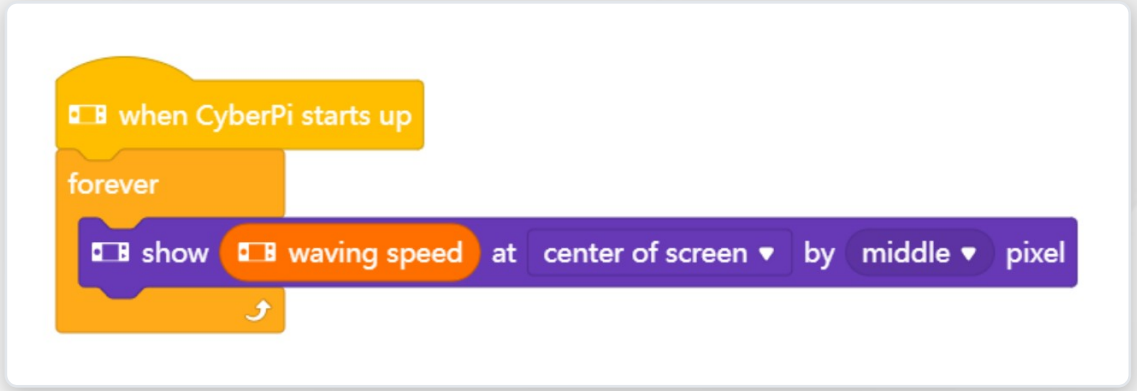
- Find these blocks in the 'Motion Sensing' category in mBlock
- They are orange — a new color to look for
- No extension needed, they are built in
- You can show any measurement straight on the CyberPi display

Measure How Hard It Is Being Shaken



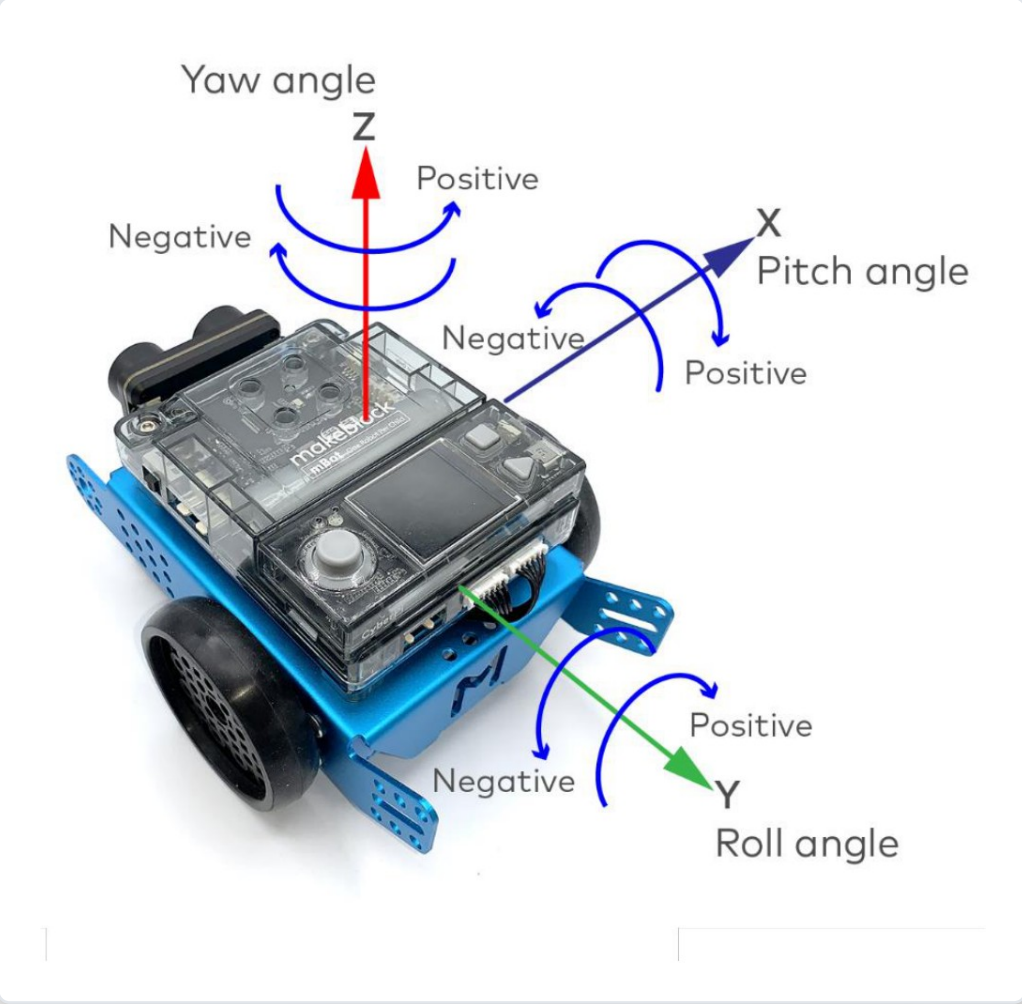
- This block reports shaking strength from 0 to 100
- 0 means not shaken at all, 100 means a very hard shake
- The example shows the strength on the display and blanks it when shaking stops
- Build it, then shake gently and hard to compare the numbers

Waving Speed Works The Same Way



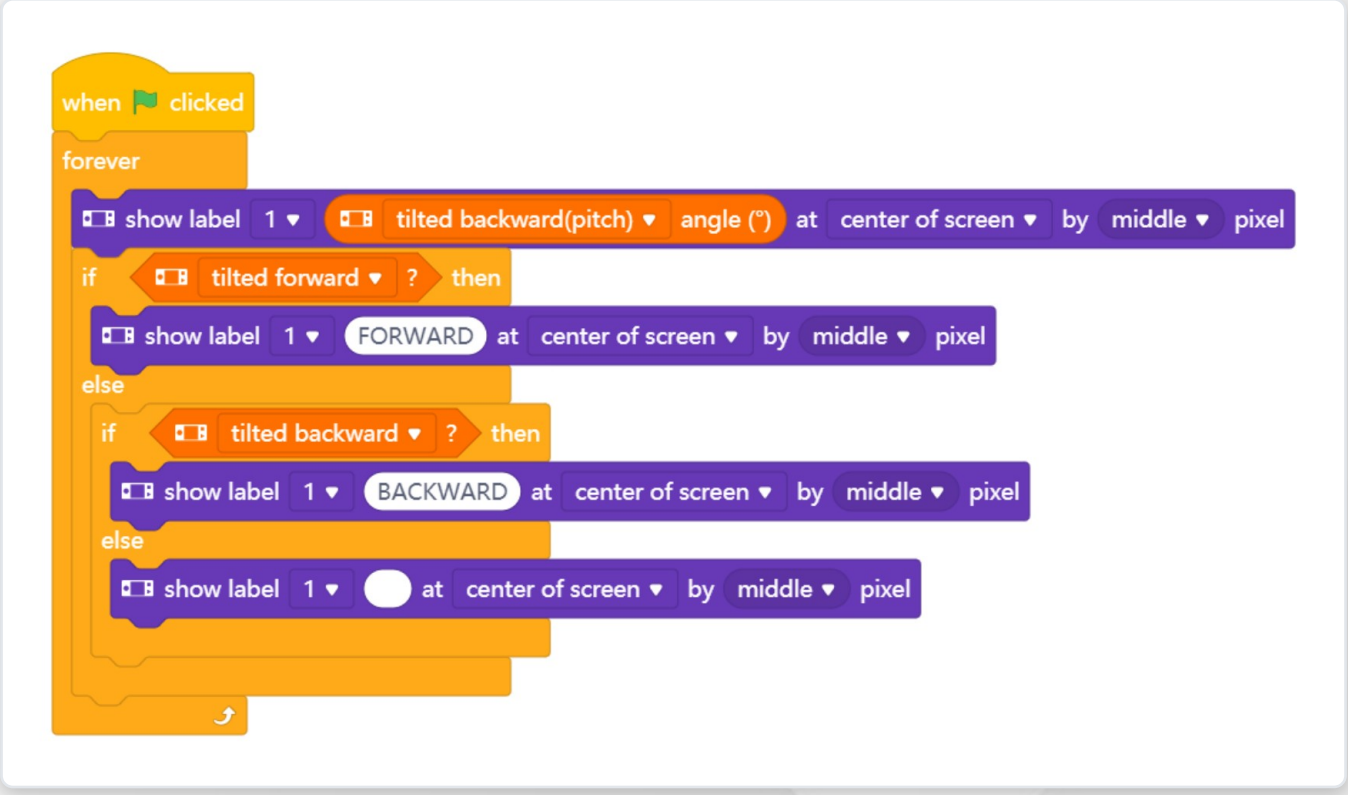
- Waving speed also ranges from 0 to 100
- These are not real units like metres per second — just a simple reference scale
- The display shows the waving speed and blanks when you stop
- Same pattern as shaking: read a value, show a value

Roll, Pitch And Yaw Come From Aeroplanes



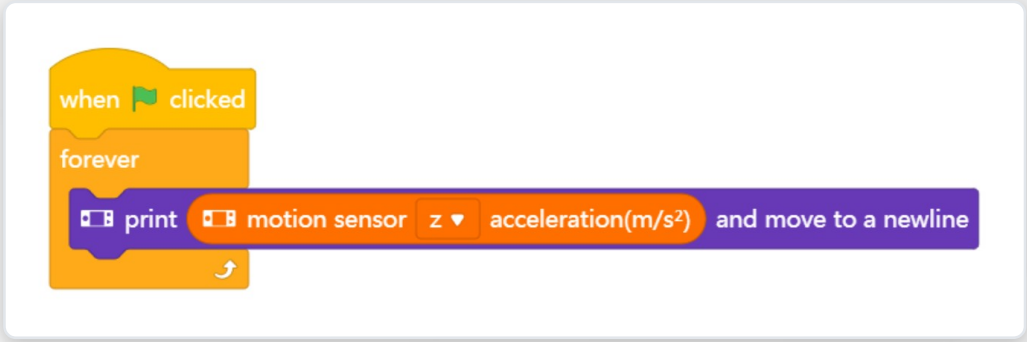
- Instead of X, Y and Z we can say roll, pitch and yaw
- These words come from flying planes
- Roll is the front-to-back axis — tipping sideways
- Pitch is the left-to-right axis — nose up and nose down
- Yaw is the top-down axis — turning left and right
- Roll and yaw go from -180 to +180 degrees; pitch from -90 to +90

Show The Pitch Angle And Name The Direction



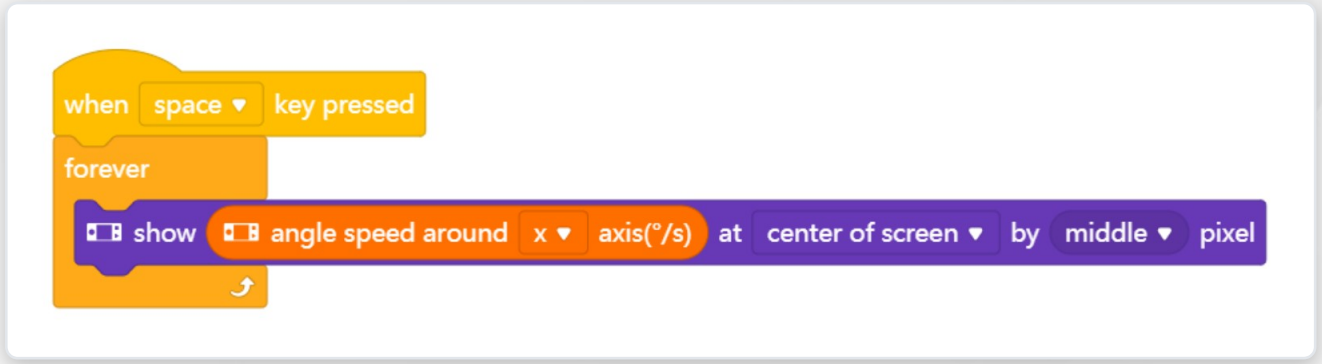
- The top row of the display shows the pitch angle
- When a tilt is detected, "forward" or "backward" appears on the last line
- Can you work out the threshold that triggers the words?
- Try other options from the dropdown menu
- Switching to tilt left/right means switching the Boolean blocks too

Detect A Crash With The Accelerometer



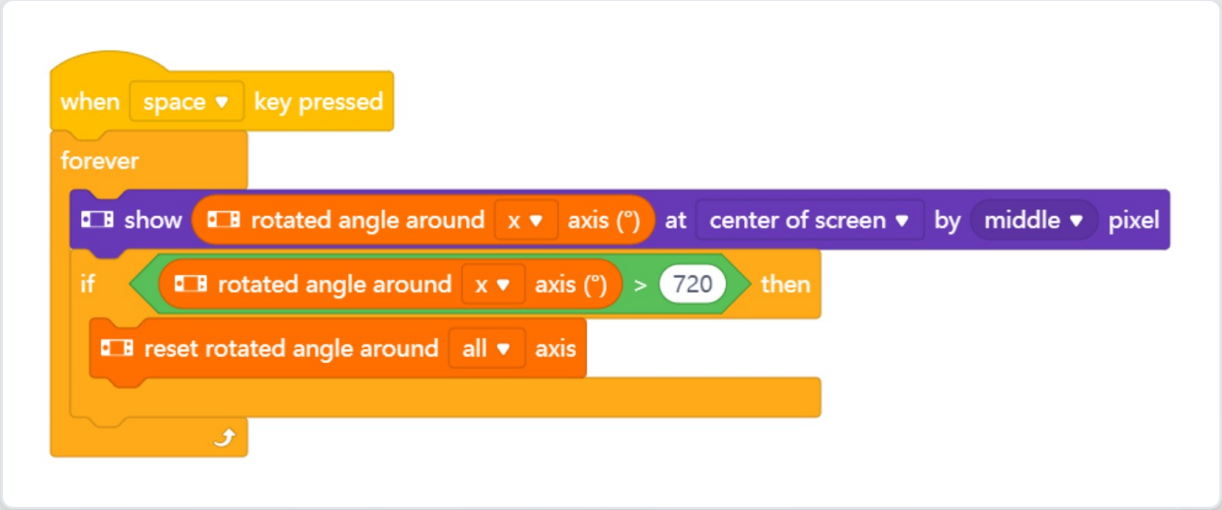
- The accelerometer measures changes in mBot2's speed over time
- That covers slow speed-ups, sudden stops, and side impacts from another vehicle
- It reports acceleration in metres per second squared
- A rapid change in acceleration means a crash has happened
- Try it: what reading appears when the robot "crashes" into your hand or a book?
- Challenge: change the program to detect a side impact instead

Angular Velocity Is Spin Speed



- This block shows how fast mBot2 rotates around a chosen axis
- The proper name is angular velocity
- It is measured in degrees per second
- Fast spin means a big number; a still robot means zero
- The example displays the angular velocity around the x-axis

Counting Rotations, And Resetting To Zero

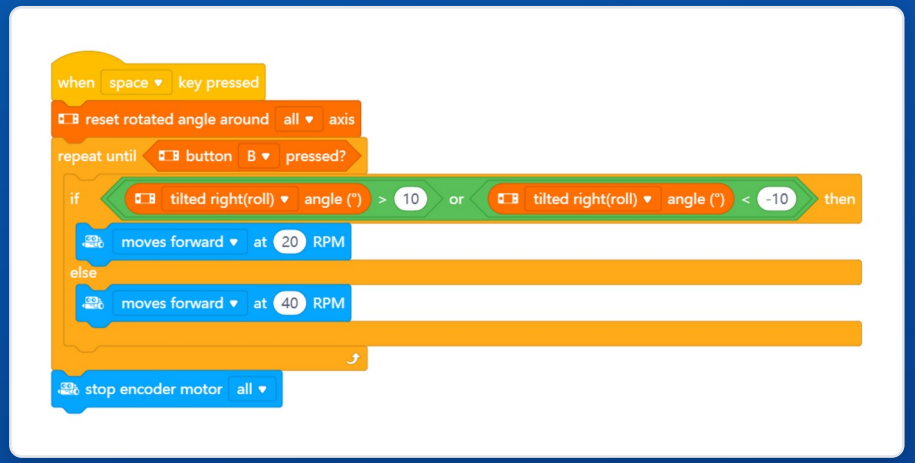


- One block reports the angle rotated around an axis, measured from switch-on
- It keeps counting past a full circle, so you can count how many turns
- Three full clockwise turns reads -1080 degrees; the other block just shows 0
- Because the gyroscope drifts, values may not return exactly to the start
- The reset block sets a measured angle back to 0 for a fresh starting point
- In the example, once the angle passes 720 degrees it resets and starts again

Your Mission

Drive Carefully On Rough Ground

- Build a program where mBot2 senses trouble and reacts sensibly
- Slow down when the ground gets bumpy so it does not tip over
- React to a sudden crash by stopping or backing away
- Plan first: what should it do, what do you need, which blocks, then test and improve
- Stuck? Ask a classmate, ask me, or use the built-in help on every mBlock block



25 minutes

Showtime and Wrap-Up

- Did your robot drive carefully over the rough ground?
- Film a short, fun movie of your careful driver
- Reflect: What turned out well? What could be better?
- Which parts were easy, and which were tricky?
- What do you want more explanation about, and who could help you?

Today you learned

- How gyroscopes and accelerometers work
- How to measure tilts, spins and shakes
- How to detect crashes and bumpy roads