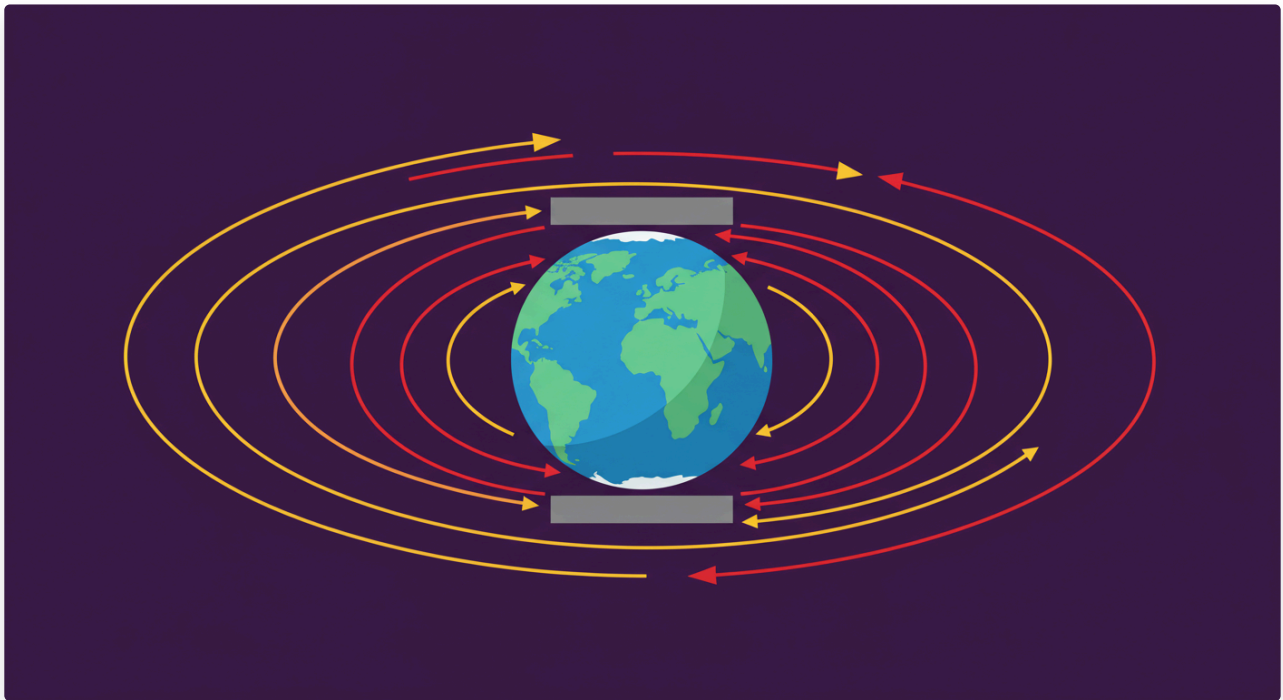


Compass Continued

Textbook

Compass Continued



Have you ever wondered how a compass always knows which way is north? It's all thanks to [Earth's magnetic field](#)! Our planet's core, made of nickel and iron, creates an invisible shield that protects us from space particles. When these particles hit the shield, they glow, creating the northern lights! Just like real compasses, the micro:bit has a built-in [magnetometer](#) that can sense direction. In this lesson, you'll learn how to program your micro:bit to act as a digital compass!

Imagine a bubble around Earth. Earth has invisible shields to protect it from dangerous things. These shields are called [magnetic fields](#). The Earth's core is made of two elements - nickel and iron, which create a magnetic field around our planet. When particles from the sun and space hit this "shield" the particles glow green. Fun fact: Have you ever heard of the northern lights? This is where that light comes from!

Magnetic fields always have two poles - north and south. A compass always points north. Compasses have helped guide people for hundreds of years!

Smartphones have a digital compass, too. For instance, when you open a maps app to guide you to your destination, you can use your phone to see which way you are driving. The micro:bit also has a digital compass, otherwise known as a magnetometer, that can sense where North is.

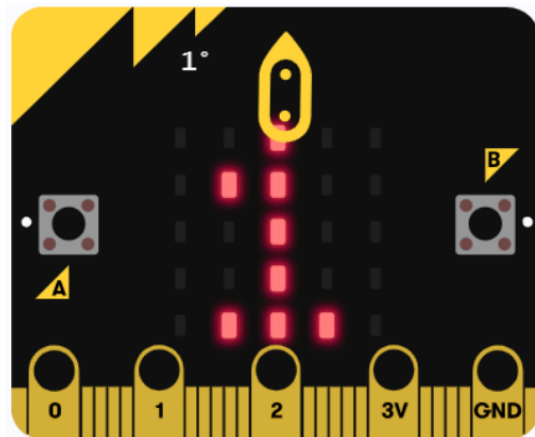
Learn how the micro:bit's compass works in this introductory video:



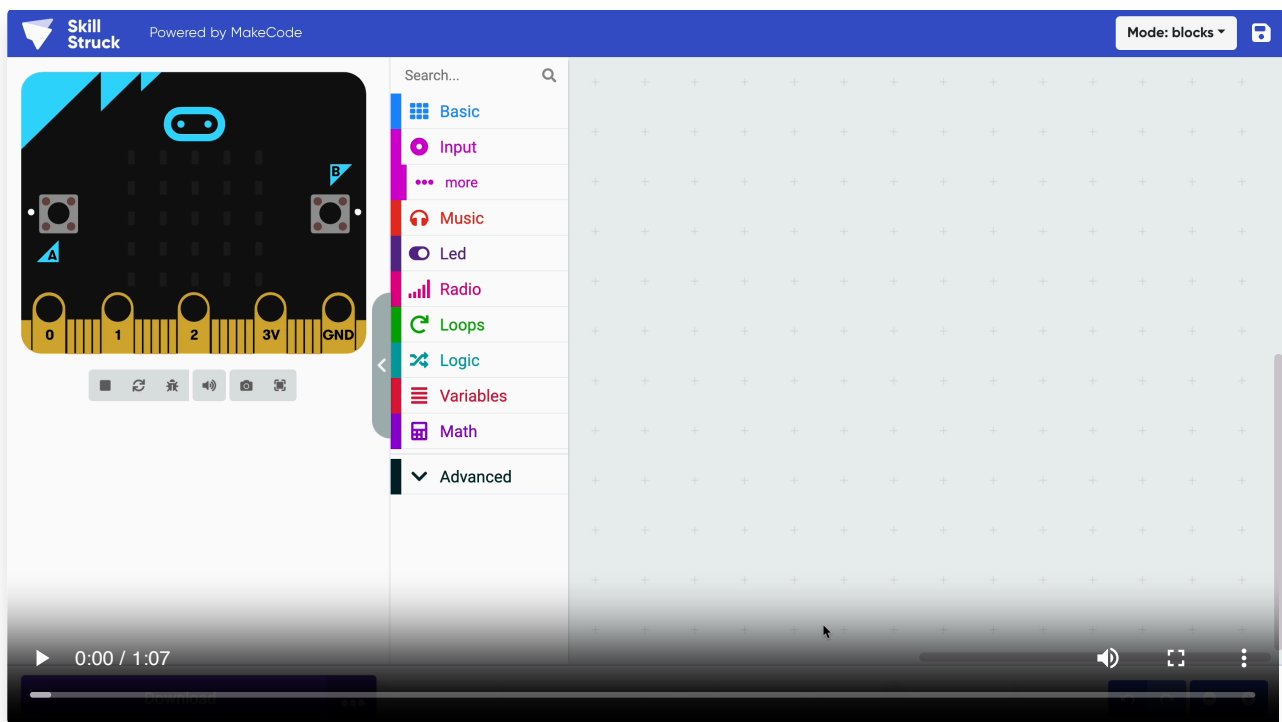
Degrees

If you were facing forward and turned to your right, that would be turning 90 degrees. If you were facing forward and turned around to face the back, that would be turning 180 degrees. If you were facing forward and turned around in a full circle that would be turning 360 degrees. Degrees are used to measure many things, and compasses use degrees to help measure distance.

Variables



To program the micro:bit to act as a compass, you will need to use a variable. A variable finds and uses information. A compass heading is an example of a variable used to program a compass. A compass heading tells you the direction you are pointing. This information is possible to track on the micro:bit because of the micro:bit's magnetometer.



Compass heading is used to track compass bearing. Compass bearing senses how many degrees you are away from the north. So if your compass heading reads 60 degrees, you are turned 60 degrees from the north direction.

How to program your compass heading using the micro:bit:

1. Drag a **forever** block into your code editor. This ensures your code works with every change as opposed to only one time.
2. Connect a **show number** block in the **forever** block.
3. Connect a **compass heading** input block and replace the 0 spot of the **show number** block.

This will program the micro:bit to show its compass heading. This means it will show how many degrees away from North the micro:bit is. Try to program this with your own robot!

Comparison Operators

There is one more concept we need to learn before diving into coding our micro:bit into a compass - comparison operators. A comparison operator compares two values or variables. Here is what these symbols look like in coding:

Greater than: **>**

Greater than or equal to: **>=**

Less than: **<**

Less than or equal to: **<=**

You can check to see if a number is greater than, less than, greater than or equal to, or less than or equal to another number. You will use variables in IF ELSE statements to practice these skills. The first challenge will walk you through a tutorial using these concepts.

Magnetic Force

Magnetic forces are often measured in Gauss. This is used to measure how strong a magnet is. For example, the average refrigerator magnet has a magnetic force of 50 Gauss. In the "more" section of the Input category we can find the magnetic force variable.

Adopted from microbit.org platform

Critical Thinking Questions

1. Why is the ability to sense direction important for both humans and technology?
2. How do comparison operators help the micro:bit determine direction?
3. What other inventions use magnetic forces, and how do they work?

Questions (5)

1. What causes a compass to always point north?

MULTIPLE CHOICE

Choose the correct answer:

- A. Earth's wind patterns
- B. Earth's magnetic field
- C. The sun
- D. Satellites

2. What are the two elements in Earth's core that help create the magnetic field?

MULTIPLE CHOICE

Choose the correct answer:

- A. Iron and gold
- B. Nickel and silver
- C. Nickel and iron
- D. Copper and steel

3. What is a magnetometer in the micro:bit used for?

MULTIPLE CHOICE

Choose the correct answer:

- A. Playing music
- B. Showing temperature
- C. Sensing direction like a compass
- D. Displaying pictures

4. True or False: The northern lights happen because of particles hitting Earth's magnetic shield.

MULTIPLE CHOICE

Choose the correct answer:

- A. True
- B. False

5. If your compass heading reads 180 degrees, what direction are you facing?

MULTIPLE CHOICE

Choose the correct answer:

- A. North
- B. East
- C. South
- D. West

Games (2)

1. Compass Continued Typing


Full Screen

Audio

Instructions

Restart

Pause



0s 100%

A compass always points

2. Compass Continued Matching

Full Screen

Audio

Instructions

Answer Key

Pause

Clear All

Check Matches

Attempts: 0

Greater than

Greater than or equal to

Less than


Less than or equal to

\leq

$<$

$>$

\geq



Robotics Challenges (6)

1. Make a Compass

Challenge

Textbook

Make a Compass

Code the micro:bit to become a compass that shows an arrow pointing North when Button A is pressed.

Requirements

- Add the input on button A pressed block.
- Add the basic show arrow block. Select North.

Answer Key

Submit

Step 1

Drag an **on button A pressed** block into the code editor.

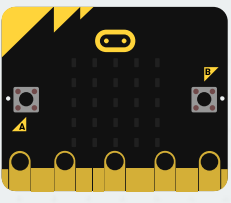
Make a Compass Step 1 of 4

1 Next

Toolbox

Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced



Download

2. Compass Bearing

Challenge

Textbook

Compass Bearing

Code the micro:bit to show the compass heading when Button A is pressed.

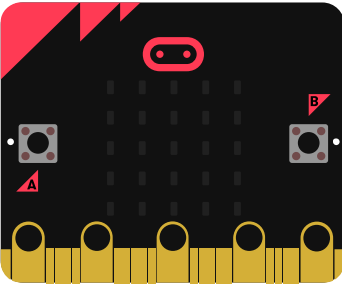
Adopted from micro:bit.org projects

Requirements

- Use the Button A input block.
- Drag a basic: show number block and connect it
- Use the input:compass heading input block to program the micro:bit and it's magnetometer.

Answer Key

Submit

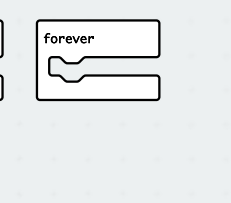


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Toolbox

Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced



Download

3. Compass North

Challenge

Textbook

Compass North

Compass heading is used to track compass bearing. Compass bearing senses how many degrees you are away from the north. So if your compass heading reads 60 degrees, you are turned 60 degrees from the north direction.

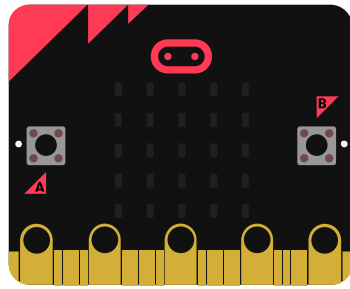
Code the micro:bit to show North when it is pointed in the North direction. North is indicated in the following degree range: 315 degrees to 45 degrees.

You will need to create a variable that says "bearing" for this challenge.

Adopted from micro:bit.org projects

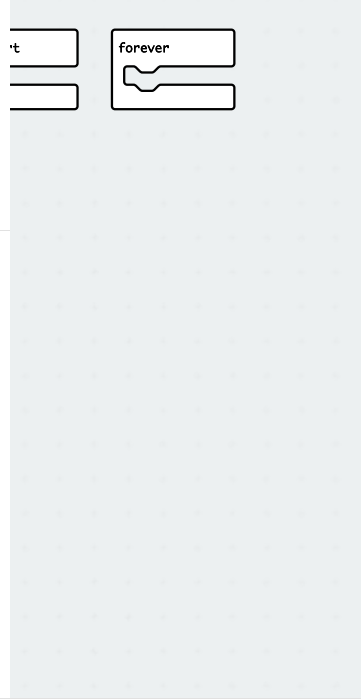
Requirements

- Begin with the basic:forever block.
- Set the bearing to the compass heading.
- Code the micro:bit so



Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced



Download

4. Compass NESW

Challenge

Textbook

Compass NESW

Compass heading is used to track compass bearing. Compass bearing senses how many degrees you are away from the north. So if your compass heading reads 60 degrees, you are turned 60 degrees from the north direction.

Code the micro:bit to show North when it is pointed in the North direction. Then, code the micro:bit to show East, West, and South as well when the micro:bit is pointed in each direction.

Here are the degrees you should follow for each direction:

North (0 degrees)

East (90 degrees)

South (180 degrees)

West (270 degrees)

You will need to create a variable that says "bearing" for this challenge.

Requirements

Step 1

Begin with the **forever** block.

Compass NESW Step 1 of 4



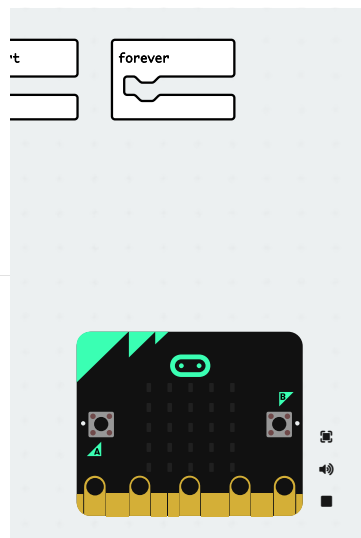
1

Next

Toolbox

Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced



Download

5. Sound Compass

Challenge

Textbook

Sound Compass

Compass heading is used to track compass bearing. Compass bearing senses how many degrees you are away from the north. So if your compass heading reads 60 degrees, you are turned 60 degrees from the north direction.

Code the micro:bit to show North when it is pointed in the North direction. Then, code the micro:bit to show East, West, and South as well when the micro:bit is pointed in each direction.

Here are the degrees you should follow for each direction:

- North (0 degrees)
- East (90 degrees)
- South (180 degrees)
- West (270 degrees)

Then, add sound to your compass so it plays a different ring tone when pointing North, East, South, and West. This way, someone who is visually impaired can use the compass.

You will need to create a variable

Step 1

Begin with the **forever** block.

Sound Compass Step 1 of 4



1

Next

Toolbox

Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced

forever

Download

6. Arrows and a Melody

Challenge

Textbook

Arrows and a Melody

Code a game that flashes 5 arrows when you press Button A. Then, program a melody to play at the same rate as the arrows flashing.

Requirements

- ☐ Play a melody
- ☐ Program code to play when Button A is pressed
- ☐ Program a loop that plays 5 times
- ☐ Show a flashing arrow

Answer Key

Submit

Step 1

Drag an **on Button A pressed** block into your code editor.

Arrows and a Melody Step 1 of 4



1

Next

Toolbox

Search...

- Basic
- Input
- Music
- Led
- Radio
- Loops
- Logic
- Variables
- Math
- Extensions
- Advanced

forever

Download

Answer Keys & Solutions

Questions

1. What causes a compass to always point north?

MULTIPLE CHOICE

Correct Answer:

- | | |
|---------------------------|-------------|
| A. Earth's wind patterns | ✗ Incorrect |
| B. Earth's magnetic field | ✓ Correct |
| C. The sun | ✗ Incorrect |
| D. Satellites | ✗ Incorrect |

Explanation:

The entire Earth has magnetic properties.

2. What are the two elements in Earth's core that help create the magnetic field?

MULTIPLE CHOICE

Correct Answer:

- | | |
|----------------------|-------------|
| A. Iron and gold | ✗ Incorrect |
| B. Nickel and silver | ✗ Incorrect |
| C. Nickel and iron | ✓ Correct |
| D. Copper and steel | ✗ Incorrect |

Explanation:

These elements help create the magnetic field.

3. What is a magnetometer in the micro:bit used for?

MULTIPLE CHOICE

Correct Answer:

A. Playing music

✗ Incorrect

B. Showing temperature

✗ Incorrect

C. Sensing direction like a compass

✓ Correct

D. Displaying pictures

✗ Incorrect

Explanation:

The magnetometer helps sense the Earth's magnetic field.

4. True or False: The northern lights happen because of particles hitting Earth's magnetic shield.

MULTIPLE CHOICE

Correct Answer:

A. True

✓ Correct

B. False

✗ Incorrect

5. If your compass heading reads 180 degrees, what direction are you facing?

MULTIPLE CHOICE

Correct Answer:

A. North

✗ Incorrect

B. East

✗ Incorrect

C. South

✓ Correct

D. West

✗ Incorrect

Explanation:

180 degrees is directly opposite of North.

Games

1. Compass Continued Typing

Typing game - no answer key needed. Students practice typing the provided content.

2. Compass Continued Matching

Matching Game Solutions:

1. →
2. →
3. →
4. →

Students must drag items from the left to match with corresponding items on the right.