

DT Challenge Year 5/6 Blockly Sport Micro:bit

<https://groklearning.com/course/aca-dt-56-bk-microbit-sport/>

About this activity

This course is designed to be an introduction to programming using the visual based coding language Blockly. The students will use this language to program small computers called BBC micro:bits.

In this challenge students will learn how to program a micro:bit to respond to interactions and movement detection. They will be able to program and then play games that test their reaction times, strength and balance using sensors already built into the micro:bit. The BBC micro:bit is a small programmable computer with built in LEDs, buttons and sensors (such as the accelerometer) that will be utilised by the students.

More and more technology is helping us to stay fit and healthy by allowing us to accurately test and monitor our physical activity. This challenge has a strong focus on the use of BBC micro:bits in real life, with most of the questions and projects designed to be downloaded to a physical micro:bit and used in real life.

Throughout this challenge students will practice 3 main programming concepts: loops, branching and variables. Loops are extremely useful when you are programming something that should respond to an interaction. Remotes are the most common example of loops, as they loop over checking if a button has been pressed constantly. While nothing is pressed they do nothing, they are waiting to check if a button was pressed and then act on that.

Branching and if statements are decision making by checking if the state of something is true or false. Depending on the state of the thing, different lines of code will be executed. This will be introduced as they program functionality into the buttons on the micro:bit, with their first if statement being “if button A is pressed do something”.

Variables store data, text or numeric, for use or analysis later. They will learn that variables can be saved containing one thing and then updated as many times as necessary, which is why they are an extremely powerful tool in the programmers kit.

Age

This challenge targets students in years 5/6, though it can also be used as an introductory course for students in later years who have not yet been introduced to basic programming concepts or who may need a refresher.

Language

Blockly, a visual programming language designed for teaching students programming concepts.

Time

The course is designed to be completed in approximately 8-15 hours of class time — it can be extended with the suggested investigation and by implementing the games they build.

Objectives, Content Descriptions & Key Concepts

Digital Technologies

Content Descriptor Code	Content Descriptor	Key Concepts	Addressed by Sport Micro:bit through:
ACTDIP018	Design a user interface for a digital system	User Interfaces	Using different displays to convey information.
ACTDIP020	Implement digital solutions as simple visual programs involving branching, iteration (repetition), and user input	Branching Iteration Tracing	Algorithms include branching, iteration, user input
ACTDIP019	Design, modify and follow simple algorithms involving sequences of steps, branching, and iteration (repetition)	Designing (Algorithms) Flowcharts Tracing	Loops to manage code repetition, decision to run when button is pressed
ACTDIP017	Define problems in terms of data and functional requirements drawing on previously solved problems	Describe problems Requirements and Constraints	Defining the requirements and implementing the solutions of the accelerometer problems

Health and Physical Education

Content Descriptor Code	Content Descriptor	Key Concepts	Addressed by Smart Garden through:
ACPPS059	Explore how participation in outdoor activities supports personal and community health and wellbeing and creates connections to natural and built environmentsExplore how	Role of sports clubs in community	Discussion on the positive impact of local club memberships/

	participation in outdoor activities supports personal and community health and wellbeing and creates connections to natural and built environments		
ACPPS058	Investigate the role of preventive health in promoting and maintaining health, safety and wellbeing for individuals and their communities.	Measuring relative health using heart rate	Discussion of measurement techniques and what results can mean
ACPMP06	Participate in physical activities designed to enhance fitness, and discuss the impact regular participation can have on health and wellbeing.	Movement as a factor of physical health	Implementation of games which encourage physical movement.

What are we learning? (Abstract)

At the conclusion of these activities students will be able to:

Sports

- Discuss the impact physical activity has on their heart rate
- Measure their reaction speed, strength and balance using the micro:bit and discuss strategies to improve
- Understand the role that sports clubs play in their community
- Understand that fitness is a component of health

Digital Technologies

- Write programs using a visual programming language
- Recognise that breaking down a problem into smaller steps (decomposition) makes it easier to solve problems
- Be able to Debug algorithms
- Recognise that steps in algorithms need to be accurate and precise
- Recognise that problems can have multiple solutions
- Utilise branching (if, if-else, and if-elif-else) in programs
- Define the term *algorithm*
- Define the term *branching*

Module outline

The course consists of 5 core modules:

1. Getting started with micro:bit
This module introduces showing images and text on the micro:bit's 5x5 LED display. It also introduces simple sequencing of steps and timing to display multiple types of output.
2. Loops, buttons and music
This module introduces the main micro:bit loop for repetition of steps. It also introduces the concept of branching by programming functionality into the buttons.
3. Simple decisions and variables
This module expands on branching decision making by programming both buttons and introduces conditions. It also introduces variables as a way to store information and introduces the micro:bit's inbuilt timer.
4. Accelerometer and loops
This module introduces the accelerometer and the generalised movements it can detect. It also goes into conditional decision making in detail and breaks conditions down to their core true or false comparisons. It also introduces a new kind of loop (while loop) so that their micro:bit can 'react' to movement.
5. Numbers and Pixels
This module breaks the LED display into its individual pixels for the first time and introduces mathematical operators so that students can start to manipulate individual pixels.

It also breaks the accelerometer into its different measurements axes so that they can start to detect more specific movements of the micro:bit.

New Vocabulary

From Digital Technologies:

Algorithm: A set of rules or step by step instructions to solve a problem or achieve an objective. A recipe is an example of an algorithm - it sets out what you need and the steps you follow to combine everything to create your food item(s).

Decomposition: breaking down a problem into smaller parts which can then be dealt with individually. This allows very complicated problems to be solved by first solving their individual parts separately and then working out how those individual solutions can be used together.

Branching: Changing the instructions executed by the program based on a certain condition. This allows you to specify that your program should behave one way in some cases, but a different way in others. In Blockly, this is achieved through the use of `if-elseif-else` blocks.

Conditions: The condition being checked during branching. It will return true or false depending on whether or not the condition being checked for is true or false. "If the button A is pressed" is a condition "If the micro:bit is shaken" is a condition.

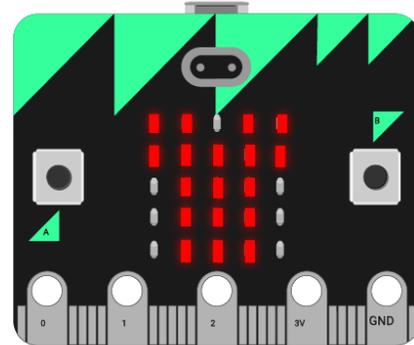
Types of component:			
 Discussion	 Worksheet	 Plugged Activity	
 Group Activity	 Unplugged Activity	 Video	
 Animation	 Reflection	 Game	 App

Overarching Activity: Egg and Spoon Race

Preparation and timing

The challenge consists of 5 modules, with an additional extension project for students who have had some experience with programming before or who move through the material quickly.

Completing all four modules should take around 8-15 hours.



Overview

- The challenge assumes no programming knowledge
- It teaches programming concepts, HPE concepts and blockly syntax concurrently

Suggested Implementation



Plugged Activity

Challenge modules

To get the most out of the modules, students should always:

- Read the interactive notes, including running any example code provided
- Attempt all problems and review questions

Clicking the **Run** button (▶) allows students to check their code by running it and **observing the output**. When they believe they have the solution correct, pressing the **Mark** button (★) will check to see if the code passes the test cases, and will provide feedback if it does not.

You can interleave the unplugged activities below with completion of the online modules, especially if you find students are struggling with a concept explored in one of the activities.

Many slides and all problems include “Teacher Notes” that verified teachers can access. These provide additional information, suggestions and activities for teaching each concept and exploring ideas further with students in class.

Activity 1 — Unplugged: Abstract Drawing

Preparation and timing

Before starting this activity, the students will need four pieces of plain paper (post-its work well) and a print out of the 5 X 5 grid (linked below).

This activity can be done prior to or during Module 1, which covers how images are shown on the micro:bit display. It could also be done during Module 3, where custom images are introduced.

Overview

- How much information is really needed to convey an idea?
- Abstraction requires the removal of unnecessary information.
- Can an animal be drawn with 25 dots?

Suggested Implementation



Unplugged Activity

Abstract Drawing

Give the students 2 minutes to draw a pig on one piece of paper and a dog on another one.

The short time frame is to try to stop them from trying to draw something too detailed.

Ask the students to show only one picture to the student next to them. Can they guess which animal it is? (encourage a little discussion about funny drawings)



Discussion

Did anyone fail to identify the drawn animal? What were the things that helped you to identify the difference between a pig and a dog?

Suggestions should include curly tail, snout, perhaps long waggy tail, tongue, pointy or floppy dog ears.

Take 2:

Try the activity again, this time have the students see if they can represent the pig and the dog on the two remaining pieces of paper with the fewest lines possible.

Have them show the pictures to their partner to guess. Was it as easy? Did anyone do a particularly good job of representing a pig or a dog in a tiny number of lines?

 **Discussion**

This is an activity based on abstraction, the students are abstracting away many details about pigs and dogs so that their key identifiers are all that remain. Computer science is all about abstraction — making sure we ignore the unimportant and distracting detail to focus on key details to solve a problem.

As humans, we abstract details all the time: if someone asks us how we got to school that morning, we generally only give them a short response (e.g. “I drove”). We don’t go into the steps we performed like what time we woke up, what side of the bed we got out of, if we got to the car from our front door or from the garage, which roads we went down, how many lights we stopped at etc etc. Similarly, for computers to solve problems effectively, they need the solution to be general (or abstract) enough that it can solve for all problems of a certain type.

Imagine if a calculator could only add 2+2 and nothing else! It would be an overly detailed solution to the addition problem. Instead, it knows what abstract process is involved in addition and executes those processes for specific numbers it is given.

Faces in 25 dots

Ask the students to suggest some facial expressions that have very identifiable characteristics.

Suggestions should include things that are represented by emoji like happy, sad, surprised, angry etc.

Get the students to colour squares on the 5 x 5 grid to represent an expression that their partner can guess.

- [Link to the 5 x 5 grid printable \(Google\).](#)
- [Link to the 5 x 5 grid printable \(PDF\).](#)

Rules:

1. They may only use one colour
2. They must colour the whole square of any square they colour

Show the pictures and ask for guesses from the class. (Encourage enthusiastic showing around the room.) Compare how many used a nose to show an expression, did anyone use ears? How many people had eyebrows? How important are these features to representing the expression? For example, showing a happy face might not need eyebrows, but a quizzical expression would need eyebrows.

Discussion questions:

- Was it hard to abstract away the least important information?
- Was it easier or harder when there was a very specific limit for how much you could draw?
- Extension: what are some other examples of abstraction (either in how humans communicate or how computers work)?

Extension - Define a sport with one piece of equipment

Ask students to pick their favorite sport. They will then have 2 minutes to draw one piece of equipment or uniform used in the sport that they think **abstractly represents** the **whole sport**.

For example, a football represents football, a tennis racquet represents tennis.

Encourage some harder examples like Running, Hurdles, High jump, Long Jump, Discus, AFL vs International Rugby.

Can they represent the sport using a symbol made up on the 5 X 5 grid?

Activity 2 — Introducing the micro:bit



Plugged Activity

[Challenge Module 1 - Displaying images and text](#)

Module 1 introduces the students to the micro:bit and displaying images and text on the 5 x 5 grid of LEDs. It starts the students thinking about the correct sequence of programming instructions. This is sequencing.

A *sequence* is a set of instructions in a computer program which the computer performs in a set order. Each instruction is executed immediately after the one before is complete.

Focus point: Draw the students attention to the “Wake up time” slide. In embedded systems the students need to add delays into the program to make sure there is enough time for humans to perceive the changes of instructions. This is represented in the micro:bit as the “sleep” time defined between images so that they have time to see the first image before it is replaced with the second.

This module also gives instructions on how to transfer the problem solutions they build onto micro:bits, which will be important to learn in order to implement the games later. We have a blog post that explains in detail how to get you and your student’s programs onto the physical micro:bit. You can read it here:

<https://blog.aca.edu.au/uploading-a-program-from-grok-onto-the-bbc-micro-bit-b89fbbac2552>



Game

Duck Duck Ghost

Students will have needed to complete the question in Module 1 titled Duck Duck, Ghost. They will also need a micro:bit, however a micro:bit example displayed on a projector screen for the class to see will suffice.

The problem called ‘Duck Duck ghost’ is a variation on the classic Duck, Duck, Goose game. Rather than being able to choose who they tag as the goose (ghost), the micro:bit will tell them to tag someone as the ghost after a certain amount of time.

As they repeat the same steps while playing the game (duck, duck until ghost, then the chase, resume the duck, duck until ghost, then chase), start to introduce them to the idea of a loop of steps. It is the next concept introduced and this is a great stepping stone opportunity.

Activity 3 — Loops buttons and music

Computers are used in so many things we don't think of as computers. Things like cars, airplanes and traffic lights, even toasters, TV remotes and smart light bulbs.

Programming is needed in all of those devices that have computers. By learning how to program embedded systems you can learn about how the world around you works!

The examples in this challenge abstract away the details of some real world embedded systems so students can explore the basic concepts of input, output, branching and iteration in real world systems without being given control of a traffic sign or a complex navigation system.

Preparation and timing

No prior knowledge is required for this activity.

This activity would be best delivered either prior to or concurrently with Module 2, where the micro:bit's branching and loops are introduced.

Overview

- An introduction to branching as a simple yes or no check
- Loops keep programs checking on repeat

Game , Discussion:

Are we there yet?

On the board, draw a house on one side called “home” and another house on the opposite side of the board called “school”. Tell the students that they must face the back of the class and you are going to draw a line connecting home to school. When students think you have finished the line ‘journey’ they should turn and say “Are we there yet?”.

If they turn around and you are **not** there yet, they are out of the game and they have to face the back again with their hands on their heads. They can only check once. First student to turn around and correctly check if you have finished wins. Play a few rounds (the line can go all over the board and in loops and squiggles to make the ‘journey’ take longer and longer).

Would students have a better chance at winning if they could check over and over and over? Of course they would! Play some rounds letting the students turn around as many times as they want. If they turn and ask “Are we there yet?” and you are not there, they must turn back before they can check again.

During that game the students were acting like little “Are we there yet?” programs. In their first round they were checking “Are we there yet?” one time, then their program finished and they were out. In the second round, their “Are we there yet?” program had a **loop** that let them check again and again.

Another example of this kind of program is a remote control. It would use useless if the remote checked if you pressed a button only once and then stopped working. Instead, the remote checks on repeat if you pressed any buttons so that it can catch when you press something and it can respond accordingly. These are loops in programming that will be introduced to in the next online module.

This game also introduces branching with 2 options. When the students turn to check they branch into two potential outcomes. If the line ‘journey’ is not finished, they must turn around and check again. If the line ‘journey’ is finished, they win.



Plugged Activity: Challenge Module 2

The second challenge module teaches branching and the micro:bit infinite loop. The micro:bit loop is what keeps the micro:bit instructions running and allows it to constantly check for and respond to button presses.

Activity 4 — More branching and Variables

Overview

- An extension of branching
- What are conditions?
- What is a variable?
- How does it relate to programming?



Group Activity, Game

Decisions with 2 options

The introduction of the **else** can be tricky as it is usually addressing the part of a decision that is implied in real life, but must be explicitly defined in computers.

Play a game similar to Simon Says to help students to understand. One student will stand out the front of the class. Simon says has an implied else to it. If Simon says “Simon says” the students do what they say. **Else, do nothing**. Have the class play Simon Says in the classic manner for a few rounds.

To make the else more explicit, have the class choose a move or stance to take if the person does not say “Simon Says”. For example, putting their hands on their heads. Write it on the board in the format “Else: (the move to do)” so that they can see it. Now, as they play, when simon does not say “Simon says” the students must make the Else move, they will be explicitly be acting out the else statement.

The important thing to remember about else statements is that they don’t check for any condition. They don’t have to.

For example;

If the answer is yes, do this. Else, if the answer is no, do that.

If they say “Simon says”, copy them. Else, they don’t say “Simon says” so don't copy them.

Can be shortened to;

If the answer is yes, do this. Else, do that.

If they say “Simon says”, copy them. Else, don’t copy them.



Game

Dance Dance Revolution

Dance Dance Revolution explores branching using the if/ elif/ else. The else should come last as it does not check anything. Remember that else does not check for anything? Elif (else if) is a way

to check multiple things in an if statement. Make sure that all options that should be checked are checked first, followed by else which covers all other options.

Discussion

What is a variable?

Variables are something that exist in the world around us but the concept proves difficult for students to grasp. At its core, a variable has a name and contents. You use the name of the variable to refer to the contents in programming. Variables can have their contents changed and updated.

A real world examples:

- The score in a sports game is a variable. It is called the 'Score' (name of variable) and the contents is the number of points scored. It is updated when a team scores more points, when someone asks for the score they are asking"
 - What is the contents of the variable named score?
- The President of the United States is a variable. The variable name is 'The President of the United States'. The contents of the variable is the name of the person who is currently in office. The name of the person changes with elections. If you talk about 'The President' other people know who you are talking about without you needing to use their name.
 - What is the contents of the variable named 'President'?

Have the students try and come up with everyday variables of their own. If you wanted to include branching you could ask the students to define what would result in a change of the variable content. For the president example, your branching example would be: "If a new president is elected, update the president variable to contain the new name."



Plugged Activity:

Challenge Module 3

The third challenge module covers variables at the end so this activity could be delivered after the completion of the module or concurrently.



Game

Reaction Time tester

This game requires the students to use variables and arithmetic. Arithmetic using the micro:bit is not explicitly covered in the early slides but the example on the slides before is very similar to what is required of them.

It might be beneficial to go through the calculation that are explained with the class a few times. Using the variable names from the problem will also help their understanding of variables and how they can contain different values.

Activity 5 - The Accelerometer and conditions

Preparation and timing

Stopwatches or a single stopwatch on a screen that the students can all see.

Overview

- What is the difference between IS_Pressed and was_pressed?
- Practicing a skill makes you improve, but you need to think about how you practice
- Accelerometers detect movement
- Ways to improve muscle strength

Accelerometer?



Unplugged Activity

The is_pressed vs was_pressed.

To illustrate is_pressed, hand the students stopwatches (or find an internet stopwatch to project for the class to see) that shows milliseconds. If it shows microseconds even better. Ask students to try and stop it at exactly 5 seconds (5:00:00 seconds). It should prove extremely difficult, if not impossible.

When they use the 'is pressed' block in their code, the micro:bit only checks if the button is pressed for a tiny amount of time, perhaps a few microseconds. Trying to press the button at the exact time the micro:bit reaches the check in the loop is like trying to stop the stopwatch at exactly 5 seconds.

The 'was pressed' is different. It doesn't actually check the button state at all! When 'was pressed' is selected, the micro:bit allocates a bit of extra memory to the button. Whenever the button is pressed that bit of memory turns on. When the micro:bit goes to check the button press it just looks at the memory bit instead. If that memory bit is on, the button was pressed.



Plugged Activity:

Challenge Module 4

The unplugged activity should be completed while students are completing the module. It rounds out the teaching from the slides and helps to give a real world example that the students can clearly see. If some students are struggling to understand the



Game



Discussion

Try not to Shake, Musical Legs

After the students have had a chance to play the balancing games, you can ask them some discussion questions about the sports aspects of the challenge.

- Did you use your arms to help you balance? Would you be as good with your arms behind your back?
- Do you think the micro:bit detected a shake more when you ran faster? Why?
- Do you think the micro:bit detected a shake more if you ran on your toes? Why?
- Could you practice balancing and get better? How?
- Do you think having stronger leg muscles will help you hold up one leg longer? What can you do to make them stronger?

Game Discussion

Milk Bottle Challenge

After the students have built their milk bottle challenge they can take turns using the micro:bit to see how long they can hold up the bottle. Some discussion points that you can cover would be:

- What different kinds of exercises can they do to make their time longer?
- What can they do to make the challenge easier for someone who is struggling to hold up the bottle?
- What is a safe stretch to use before you try this challenge ? What about after?

Activity 5 - The Final Module

Preparation and timing

The final module builds to creating an egg and spoon race micro:bit program. Play some rounds of the classic game with students just in case they have forgotten how or have never played it before.

Overview

- You can update a variable using itself
- How to turn individual pixels on and off
- X and Y coordinates
- How Accelerometers work and what the values mean

Unplugged Activity

Updating Variables

Increasing the value of a variable by itself can be a tricky thing for students to understand. They have to stretch their abstract thinking quite far to keep in mind that the variable value can be on both sides of the equals sign.

Learning to update the variable using the existing variable is an important part of learning to use variables effectively. Working through the examples in front of the class will be extremely useful for the students, and they will need lots of examples.

A good real world example to use would be the updating of scores during a sports game. When a team scores a goal, the points are added to their already existing score. You can find examples of scores from local football games played over the weekend and use them as examples on the board. (Look for games with high score totals so that you have lots of goals to work with) It will help students to be engaged if it is teams they support.

Work through the addition of each goal using only number/s initially, then replace the starting score with a variable name such as “score”.

Score = score + (number)

If you wanted to extend it further, you could replace the number of points with the name of the type of goal, and have the students calculate what the new score will be. For example:

Score = score + Try

Score = score + converted try

Score = score + penalty



Unplugged Activity

Pixel Bingo

Before starting this activity, the students will need a few copies of the print out of the 5 X 5 grid (linked below). This activity is best done **after** students have had a chance to read the “Pixel layout” slide in module 5 of the course which explains how to interpret the coordinates of each pixel.

Ask the students to randomly choose 10 pixels out of the grid and colour them in.

- [Link to the 5 x 5 grid printable \(Google\).](#)
- [Link to the 5 x 5 grid printable \(PDF\).](#)

You then read out pixel coordinates at random, the students must find that coordinate on their 5 x 5 sheet. If it is one of their coloured pixels they mark it off. Keep calling until one student has marked off all their chosen pixels and calls “Bingo!”.

Extension:

Ask the students to update their chosen pixel coordinates by adding 1 to both x and y.

$x = (x + 1)$ and $y = (y + 1)$

If their coordinated become a 6, they must reset it to a 0. Give them a second 5 x 5 grid and ask them to add one to each of their old square coordinates and fill out new squares. This replicates what they will be programming later, where they must stop a moving pixel from 'falling off the edge of the micro:bit' by resetting coordinate values of 6 back down to 0..

After they have updated their bingo sheets, play a few more rounds of bingo. If you want to make it trickier, you could read out a coordinate and ask the students to mark their sheets at the +1 values of the coordinate you read out.

Worksheet, Unplugged Activity **Micro:bit axis helper (Accelerometer X, Y and Z)**

Access the worksheet here:

[Axis Helper Worksheet](#)

Planning: Students will need a pair of scissors. This activity should be completed during or directly after Module 5, slide titled "Accelerometer X and Y (and Z!)".

Thinking in 3D space can be difficult, giving the students something physical to give them feedback will help.

Have the students complete and build the micro:bit axis helper worksheet. The sheet is designed to help them to interpret the accelerometer x and y values relative to the position of the micro:bit. They will need a pair of scissors if they want to build their own Axis helper for use during their final project. They can also use a real micro:bit on the helper if they prefer.

This worksheet complements the beginning of Module 5 and can be completed as a class activity or individually. After they have completed the sheet, ask the students to demonstrate the micro:bit position associated with different axis measurements you provide to test their understanding. The final page is a cut out which they can fit onto a real micro:bit that will show them which axes are adjusting to which movements.

Plugged Activity **The final project**

As students attempt the module it may be important to remind them that the blocks and structures they are using to build it have all been encountered before. They should also be encouraged to break the project down into clear steps if they seem intimidated by the scale of the final instructions.

Testing the micro:bits in real life will also help them to get a sense of how things are progressing and help them to see where their program may be failing.

Discussion:

Discussion Questions:

- Is there a way that someone can cheat this game in its final form?
- How would you optimise against cheating?
- How sensitive is the micro:bit to tilting in its current state? How could you make it more/less sensitive?

What other games do you think you could build on the micro:bit??

There is a playground located at the end of the Module, it contains all the blocks used throughout the prior modules as well as blocks that they have not encountered before.

If students do build their own, please let us know! Send their projects to help@aca.edu.au!