Measuring area

Content summary:
A whole class data collection activity that uses the BBC micro:bit as a distance calculator to measure distances within the school playground. Pupils use these distances to calculate area.

Time: Approx. 2 hours 30 min split up into 4 sessions.

Session 1: Introduction and planning (30 min)

Resources required	Prior learning	Before the lesson
• Map or image of playground (see Getting started activity). • Measuring area video on BBC Teach activity guide. • Playground survey pupil worksheet. • Playground survey glossary. • Chalk or tape (optional).	**Maths** • Measuring area. • Calculating the area of regular polygons.	• Gather all resources required. • If you have not completed the Getting started activity, display or print a map of the playground to look at with your class – this could be a hand-sketched map or an image from the internet. • Decide which parts of the playground you are measuring – we suggest you include everything children can play on, every playtime, every day. • Make sure that natural and synthetic surfaces are separated into different sections if you want to answer the optional question: ***What is the ratio of natural space to synthetic space?***

Differentiation

Group pupils in any way that works for your class. Mixed ability pairs or small groups work well.

Session details

1. Recap the BBC micro:bit playground survey and introduce this survey activity using the Measuring area video on BBC Teach.
2. Highlight the key question we want to answer:
   What is the area of our playground?
3. Explain that the micro:bit is not automatically programmed to be a distance calculator, but we can program/code it to become one.
4. Recap class understanding of area.
5. Explain that the micro:bit will help us measure distances that we then use to calculate area.
6. First, pupils need to problem-solve to get the area of the playground using length x width = area.
7. Share an overhead view of the school playground on screen or via maps.
   Ask *'How can we find the area of our playground?'* and collect ideas.
8. Focus the class on the shape(s) of the playground – only look at the specific area that you will measure for the survey (the map from the Getting started activity establishes these boundaries).

9. Encourage pupils to problem solve and use shapes such as squares and rectangles so they can find the area of smaller sections that can be added together to make up the total area.
10. If helpful, draw sections/shapes directly on the map and/or go outside and use chalk or tape to divide the playground into squares/rectangles.
11. You can decide not to include some parts of the playground if it is not feasible for your pupils to find the area using length x width.
12. Label each section with a letter.
13. Organise which pupils will measure which sections of the playground. You could ask pupils to take measurements more than once and find an average, but if sections are being measured by multiple pupils already then you may not need to do this.
14. Share the pupil worksheet in advance so the pupils are familiar with it before going outdoors.

Session 2: Optional coding (30 min)

Resources required	Prior learning	Before the lesson
• Measuring area micro:bit how to guide including coding video. • Image of distance calculator code available on micro:bit how to guide • Code on MakeCode or distance calculator hex file. • BBC micro:bits, battery packs and batteries (one per pair or group). • To put code on your micro:bit you will need one of the following: • A computer (e.g. laptop or Chromebook) and a micro:bit USB lead • An Android tablet with the micro:bit USB lead and an adaptor (support article with more detail for Android tablets). • An Apple iPad with Bluetooth enabled and the micro:bit app (support article with more detail for Apple iPads)	**Computing/ICT/Technology** • Creating an algorithm to solve a problem. • Combining code blocks to create a program. • Understanding inputs. • Understanding of simple variables (this activity could be a first introduction).	• Check pupil computers allow micro:bit drive to display (more information here). • Have the Measuring area micro:bit how to guide and coding video ready to share. • Display image of distance calculator code. • Make sure batteries are in micro:bit battery packs.

Planning

If you want to skip to the Fieldwork session, you will need to make sure the code is transferred the code to the micro:bits in advance. You can download the distance calculator hex file from the Measuring area micro:bit how to guide.

Session details

1. Open the distance tracker code in MakeCode, show the code on screen and talk through how it works.
2. Watch the micro:bit coding video in Measuring area micro:bit how to guide with your class and take note of key points, including how to create the variables ‘step count’ and ‘step length’.
3. Ask pairs or groups to go to makecode.microbit.org and create the distance calculator code on their device.
4. Demonstrate how to transfer the code to the micro:bits and ask pairs or groups to transfer the code. If you are using tablets, then please follow these instructions.
5. Once pupils transfer the code, they should test it by pressing button A on their micro:bit, then button B, to see if the distance shown on the LEDs increases. Then press the reset button on the back to delete the test data.
6. Pupils do not need to keep the same micro:bits that they have programmed. They can be gathered up and powered off, and the code will stay on the micro:bits ready to use in the next session.

Optional session extension: Calculate your class step length (extra 20 min)

1. The code for this project comes with a predetermined class 'step length' of 0.6m. We asked lots of children to test it for us and this was their average step length.
2. However, if you wish, you can calculate a new average 'step length' based on real data from your class.
3. Measure 10m, then ask each pupil to walk the distance and count how many steps they take.
4. Calculate the average number of steps taken over 10m for your class. Then divide 10 metres by the average number of steps to get the 'step length' number to use in the code.
5. This value can be updated on the code using MakeCode and your amended code can be downloaded to use on your micro:bits.
6. For ease, we still recommend you use a class average, so pupils can use any class micro:bit for fieldwork.

Session 3: Fieldwork (45 min)

Resources required	Prior learning	Before the lesson
• BBC micro:bits, battery packs and batteries (one per pair or group). • Pupil worksheets for recording and pens or pencils. • Map showing rectangles (optional).	**Maths** • Standard and non-standard units of measurements. • Understanding of length and width. • Understanding of measurement and averages.	• Ensure the code is on the micro:bits and the batteries in the battery packs are working. • Distribute pupil worksheets for recording when outdoors.

Differentiation

If specific children need support taking their measurements, provide additional support through who they are partnered with or through additional tools.

Session details

Discuss what the code is telling the micro:bit to measure and how to be accurate (10 min)

1. Ask children what units of measurement they will be using for the activity.
2. If your class have not programmed the micro:bits themselves, share the code and highlight 'step length' in metres.
3. Highlight that they will also be using another value: the number of steps. Ask class: ***Can steps be used to accurately measure?*** Discuss.
4. Link to previous learning on non-standard units of measurement.
5. Elicit the importance of using consistent step lengths when using our step as a measuring tool. Working methodically in pairs will help pupils keep consistent and accurate.

Model how to use the distance calculator (5 min)

6. Give a demonstration making sure pupils understand the need to walk with regular step sizes.
7. Remind pupils that they will be using the distance tracker to measure the area of the playground, therefore they need to measure each length and width as precisely as possible.
8. They need to know where they are starting and stopping.

Use distance tracker in the playground (30 min)

9. Once they are in position remind them that they need to reset their micro:bit by pushing the button on the back, before stepping & clicking the distance, then record it on their sheet.
10. Reset again and repeat as needed.
11. It may help with accuracy to measure distances 3 times to get an average. If pupils are measuring the same distances multiple times to get an average, then remind them to clearly note different sets of measurements on their recording sheet.

Troubleshooting:

- Ensure battery pack wires are clicked in fully before beginning.
- Walk slowly and allow time for each button press to register as you take each step.
- Press reset to begin measuring again if you make a mistake.

Session 4: Data analysis and recording (45 min)

Resources required	Prior learning	Before the lesson
• Pupil worksheets from the fieldwork session. • Calculators (optional). • Playground survey poster.	• Regular 2D polygons. • Calculation of area of regular polygons.	• Decide if you need other methods of support alongside calculators. • Decide if any groups will answer the optional questions about areas of synthetic and natural surfaces.

Differentiation

Use tools and differentiation appropriate to your class to find the average area of the playground sections and total the area of the playground sections. You may find calculators or a spreadsheet helpful if you have a very large number of playground sections.

Session details

Calculate the area of playground in metres squared (30 min)

1. Work as a class to calculate the total area of your playground, the area of natural surfaces (optional) and the area of synthetic surfaces (optional), or task different groups with each of these calculations.
2. Ensure your data is as robust as possible by identifying and removing outlier results.
3. Record your results on the playground survey class poster.

Discuss findings (15 min)

Link back to what we wanted to find out:

5. ***What is the area of our playground?***

Questions:

1. *How do you think this will compare with other playgrounds in the UK?*
2. *Are there challenges for us in terms of how we use the space?*
3. *Do you think we use all the space we have?*

Looking ahead:

4. *What action do we want to take based on our findings?*