Comparing surface temperatures

Content summary:
A whole class data collection activity that uses the BBC micro:bit as a thermometer to record surface temperatures in four different areas of the school playground.

Time: Approx. 2 hours, split up into 4 sessions.

Session 1: Introduction and planning (20 min)

Resources required	Prior learning	Before the lesson
• Map or image of playground with locations noted (see Getting started activity). • Comparing surface temperatures video on BBC Teach activity guide. • Playground survey pupil worksheet • Playground survey glossary.	**Science and Maths** • Understanding of temperature as a measure of how hot something is. • Units of measurement - degrees Celsius. • Properties of materials. • Meaning of natural and synthetic.	• Gather all resources required. • Locate playground surfaces made of different materials, two natural, two synthetic, all in sun or all in shade.

Differentiation

Think about groupings and volume of data and group pupils in any way that works for your class. Mixed ability pairs or small groups work well, but the number of readings taken will impact the volume of data that will need to be collated and averaged.
Assigning small groups to specific locations can help reduce the volume of data.

Session details

1. Recap the BBC micro:bit playground survey and introduce this survey activity using the Comparing surface temperatures video on BBC Teach.
2. Highlight the question we want to answer:
   How does the surface material of our playground affect the surface temperature?
3. Explain that the micro:bit is not automatically programmed to be a thermometer, but we can program/code it to become one.
4. Decide on four places to take surface temperature readings to compare temperatures experienced in the playground. You need two synthetic surfaces and two natural surfaces. Make sure they are all in sunlight or all in shade - that way it will be easier to compare your temperatures and spot patterns.
5. Ensure pupils understand that when the micro:bit is lying flat on a surface, it will register the temperature of that surface, not the ambient temperature - they will compare *surface* temperatures.
6. Ensure understanding of surface temperature and natural/synthetic by using two contrasting surfaces in your classroom and demonstrating how to lie the micro:bit directly on the surface.
7. Discuss properties of materials and why we may expect different temperatures.
8. Ask class to predict the warmest surface and coldest surface, making a note to refer back to later.
9. Share the pupil worksheet in advance so pupils are familiar with it before going outdoors.

Session 2: Optional coding (20 min)

Resources required	Prior learning	Before the lesson
• Comparing surface temperatures micro:bit how to guide including coding video. • Image of thermometer code available on micro:bit how to guide. • Code on MakeCode or thermometer 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 Chrome-book) 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** • An understanding of the features of a micro:bit including the temperature sensor. • Combining code blocks to create a program	• Check pupil computers allow micro:bit drive to display (more information here). • Have the Comparing surface temperatures micro:bit how to guide and coding video ready to share. • Display image of thermometer 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 to the micro:bits in advance. You can download the thermometer hex file from the micro:bit how to guide.

Session details

1. Open the thermometer code in MakeCode, show the code on screen and talk through how it works.
2. Watch the micro:bit coding video in the micro:bit how to guide with your class and take note of key points.
3. Ask pairs or groups to go to **makecode.microbit.org** and create the thermometer 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 taking a temperature reading using the micro:bit.
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.

Session 3: Fieldwork (50 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 surface locations (optional).	**Science** • How to use a thermometer to measure temperature including allowing time for regulation.	• 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 counting to 60 multiple times, provide additional support through who they are partnered with or through additional tools.
The first two columns on the pupil worksheet are necessary, but the third is optional. More able children can be challenged to complete all columns.

Session details

Model how to use the thermometer (10 min)

Explain that the temperature sensor is housed inside the micro:bit processor and when you move your micro:bit from one location to another, the sensor needs time to adjust. We recommend the following:

1. Place the back of the BBC micro:bit directly on the surface and count to 60, so that you are waiting approximately 1 minute.
2. Press button A to take the 1st reading and record it on the pupil worksheet.
3. Count to 60 again and press button A to record the next reading.
4. Repeat until you record three temperature readings that are the same – this means the temperature has stopped rising/falling and you have a true temperature for that location.
5. Ask pupils to note the temperature readings in a list and circle the three readings that are the same.
6. Tell pupils to stop after 10 readings even if they have not had three the same - they can use the final reading.
7. Move the micro:bit to the next location and repeat the process.

Discuss the impact of sun or shade (5 min)

8. Make sure pupils are aware the four locations have been chosen to ensure they are all in the sun or all in the shade so that it will be easier to compare them and spot patterns or differences.
9. Discuss why this is needed.

Take surface temperature readings in your playground (35 min)

10. Ask pupils to go to the four chosen locations in the playground and take readings, recording them on the playground survey pupil worksheet.
11. Make sure they note down the description of surface as well as the location. (Diagram on recording sheet is optional.)
12. Taking repeat readings is part of the learning and changeable weather may increase the time needed to get three consistent temperature readings. See note above regarding a maximum of 10 readings.

Troubleshooting

- Ensure battery packs are clicked in fully before beginning.
- Ensure micro:bits placed directly on the ground are not in a location where they could be stepped on nor placed in a damp area.

Session 4: Data analysis and recording (30 min)

Resources required	Prior learning	Before the lesson
• Pupil worksheets from the fieldwork session. • Playground survey class poster. • Calculators (optional).	**Maths** • How to calculate the average/mean (not essential as teacher-led, class activity).	• Decide if you will use calculators or other methods of support.

Differentiation

Use tools and differentiation appropriate to your class. You may find calculators or a spreadsheet helpful, or task different groups with working out the average temperature for each location.

Session details

Calculate the class average for each location (20 min)

1. Calculate the class average for surface temperatures recorded in each of the four areas.
2. Ensure your data is as robust as possible by identifying and removing outlier results.
3. Record your results on the playground survey poster.

Discuss findings (10 min)
Questions:

1. *What surface temperatures did you experience in different parts of your playground?*
2. *What are the differences between these four readings and what conclusions can be made from this?*

Link back to what we wanted to find out:

3. *How does the surface material of your playground affect the surface temperature?*
4. *Were our predictions correct?*

Look ahead:

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