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# Solar kit scheme of work

## Scheme introduction

The aim of this scheme is to engage students with programming concepts through the building and programming of circuits using the micro:bit and the solar kit components. The MonkMakes Solar Experimenters Kit for micro:bit is a project kit that allows you to experiment with harvesting energy from the sun and other light sources. It consists of a solar panel to harvest the energy, a solar store that stores the harvested energy, and a low energy light bulb and a motor that can be driven with the energy that you harvest. The kit itself comes with a solar experimenters kit for micro:bit booklet which contains six experiments of increasing complexity. This scheme overlaps with the kit booklet but takes aspects of the lessons which can be taught to a class of computing students and delivers them in easy to manage lesson-sized chunks to maximise class time and learning.

Some of the projects in this scheme are a little longer and more involved than other Monk Makes micro:bit component projects so the ones that are delivered are taught across two or three lessons. After the 2nd lesson in the scheme it is helpful, for maximising the learning time, if the powered circuits can be left somewhere in bright sunlight so that the solar store can build up enough charge to power the fan and show how the barchart reflects the full solar store.

In each lesson the students focus on one or two specific concepts or features which are utilised by that lesson’s program. Additional concepts are introduced throughout the lessons, via a slide presentation and either through worksheet exercises or directly demonstrated by the program. The main programming concepts and features within this unit are control provided by the micro:bit, use of micro:bit connections, iteration, trace tables, algorithms, pseudocode, decomposition and functions. As this project focuses on the use of solar power and charging solar stores there is opportunity for highlighting cross-curricular links with the physics, electronics and geography curricula. All the examples and activities for this unit use a micro:bit and Monk Makes Solar kit.

## Prior knowledge

It is assumed that the students will have previously learned the basics of how to flash programs to the micro:bit and have a basic understanding of python.

## Outline of lessons

| **Lesson** | **Focus of lesson and brief overview** | **Learning objectives** |
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| Lesson 1: Introducing the solar kit and garden light.  N.B. This lesson does not use the micro:bit | *Focus: introduction to solar kit, limitations of the solar circuit without*  *a micro:bit*  Students are introduced to the functionality of the solar kit. They label the parts of the solar store in order to understand the different aspects of the component using a starter exercise and worksheet.  The students then build the garden light circuit and using either bright sunlight or a bright artificial light they charge up the solar store, linked to the solar panel until the low energy light comes on. They try the garden light experiments and answer questions e.g. once the Bulb is shining brightly if you disconnect the Solar Panel from the Solar store, how long is it before the Bulb goes out. The students also adjust the circuit slightly to operate the fan, instead of the low energy bulb. In addition they discuss the limitations of the circuit without a micro:bit as a primer for the next lesson in the scheme. Finally they revisit the label exercise from the start as a plenary to demonstrate their understanding of the solar store. | * Understand the purpose and functionality of the solar kit * To be able to label the solar store * To successfully set up a garden light circuit * Understand the limitations of a circuit without the micro:bit |
| Lesson 2: Solar kit - energy meter part I | *Focus: understanding of the connections between the micro:bit and other hardware*  The focus of this lesson is to illustrate the use of a for in range loop in a practical way. The lesson starts with activities which demonstrate the syntax and purpose of a for in range loop and enables the students to practice them through class and individual exercises. The students build the energy meter circuit and flash the code to the micro:bit. They then attempt to write a couple of sentences which provide a high level description of what the energy meter program does. The students are given the coding of the program at the correct level and are asked if they can complete the missing lines. The teacher undertakes a whole class exercise to work through understanding the code together and starting the code conversation. During this time the solar store will be gaining more energy which will be shown on the bar graph on the micro:bit. Finally, they complete a plenary to demonstrate their understanding of some of the features of the micro:bit.. | * To successfully set up a micro:bit/energy meter circuit and flash code to the micro:bit * To understand the significance of the different pin connections from the solar store to the micro:bit * To be able to read and interpret a program containing a bar chart function * To be able to read and interpret a program containing for loops |
| Lesson 3: Solar kit - energy meter part II | *Focus: iteration - iteration/loops and trace tables*  The focus of this lesson is to illustrate the use of iteration in a practical way and show how trace tables are used in programming. The lesson starts with activities which demonstrate the syntax and purpose of the different loops and enables the students to practice them through class and individual exercises. The students then undertake a trace table individually and with the class to follow the change in variables. The students then revisit the energy meter program, seeing if they can recall the code conversation from memory, demonstrating their understanding. They are then invited to make changes to the program to reflect the increasing charge. This could be done by using micro:bit emojis or numbers on the micro:bit display. Finally, they complete a plenary to demonstrate their understanding of trace tables by completing another trace table individually. | * To successfully set up a micro:bit/energy meter circuit and flash code to the micro:bit * To be able to read and interpret a program containing user defined functions * To be able to understand iteration and apply it effectively in a functioning program * To successfully use trace tables to test a program |
| Lesson 4: Solar kit intelligent cooling fan part I | *Focus: algorithms & pseudocode*  The focus of this lesson is to illustrate the use of pseudocode in the compilation of complex algorithms. The lesson starts with activities which examine the students' understanding of algorithms and pseudocode conventions. They then go on to build the intelligent cooling fan program then with support write a high level algorithm for a program using pseudocode. The focus is very much on how we work with the inputs and outputs of the micro:bit and convert the figures provided by electrical current into figures which work well with the LED output of the micro:bit.  Finally, they complete a plenary to demonstrate their understanding of the syntax. | * To successfully set up a micro:bit/intelligent cooling fan circuit and flash code to the micro:bit * To recall the definition of an algorithm * To apply their knowledge of algorithms and pseudocode to a specific problem * To be able to read and interpret a program containing user defined functions |
| Lesson 5: Solar kit intelligent cooling fan part II | *Focus: decomposition*  The focus of this lesson is to illustrate the use of user defined functions in a practical way. The lesson starts with activities which demonstrate the purpose of decomposition and enables the students to apply and develop their knowledge through individual and class activities.. The students then revisit the intelligent cooling fan ‘code conversation’ to demonstrate their understanding of the program syntax. The teacher works through the program with the students and ensures that they understand this.  Finally, they complete a plenary to demonstrate their understanding of decomposition in the real world and programming context. | * To successfully set up a micro:bit/intelligent cooling fan circuit and flash code to the micro:bit * To be able to read and interpret a program containing user defined functions * To understand the purpose of decomposition * To successfully apply decomposition to a range of problems |
| Lesson 6: Solar kit intelligent cooling fan part III | *Focus: selection - Program modification and making*  The lesson starts with a brief review of decomposition and functions from the previous lesson.  At this stage the students have studied two long programs in detail and focussed on decomposition, pseudocode and different types of loops.  All are invited to make a small modification to the most recent “Intelligent Cooling Fan” program and will be given the option of starting another program from scratch using any of the components in the solar kit. | * To successfully set up a micro:bit/intelligent cooling fan circuit and flash code to the micro:bit * To be able to successfully modify a program containing multiple programming constructs * To be able to successfully make a program containing multiple programming constructs * To answer questions about the solar store and programming constructs and concepts |