**Volcano animations**

**Lesson 2: Flowcharts & repetition**

**Introduction**

In this lesson pupils learn how algorithms can be written in the form of flowcharts by representing their dance sequence developed in the previous lesson. They then program this sequence using the micro:bit MakeCode editor and explore how the concept of repetition can be used to achieve animation.

**Time:** @60 minutes

**Materials needed:** lesson presentation, printout of the *LED Planner* from slide 3, paper for pupils to write their flowchart algorithms, scissors and glue sticks, [microbit-simple-dance.hex file](https://makecode.microbit.org/#pub:_Ekrez99KjAbV), micro:bits and USB leads (if you have them).

**Learning objectives**

* To understand the use of repetition
* To write simple flowchart algorithms using repetition
* To write programs based on algorithms using repetition

**Lesson summary**

* LEDs Dance (10 minutes)
* Flowchart algorithms (15 minutes)
* Programming animations (15 minutes)
* Exploring repetition (10 minutes)
* Reviewing repetition (10 minutes)

**Introduction: LEDs Dance (10 minutes)**

* Display a copy of the *LED Planner* (**slide 3**) and ask pupils to consider how they have previously used the planner when working with the micro:bit (**slide 4**).
* Use this opportunity to recap on abstraction (developed in the **Nature art** and **Digital flashcard** units) and discuss how their dance sequence can be recorded on the LED planner.
* Ask pupils to record an image to represent each step, cut out each image and arrange them in the correct sequence (**slide 5**).

**Flowchart algorithms (15 minutes)**

* Explain to pupils that they are going to explore how animation can be created using a micro:bit by planning and programming their dance sequence.
* Display **slide 6** and ask pupils to explain what is being shown: an algorithm for washing your hands in the form of a flowchart. Ask pupils to identify any patterns they notice in the blocks that are used: start and stop blocks are oval, action boxes are rectangles.
* Explain that pupils are going to use the images from the LED Planner to create an algorithm in the form of a flowchart (**slide 7**). Invite pupils to suggest how this may look and model their ideas. If pupils do not address the need for delays between the images stimulate their thinking by asking how they can make sure that the image is displayed long enough for someone to see it.
* Give pupils time and materials to create an algorithm in the form of a flowchart using the images they have already created.
* Once finished, invite them to share their algorithm with another pair/group to test and debug as necessary.

**Programming animations (10 minutes)**

* Display the MakeCode editor and invite pupils to show how to program a first image from a dance sequence algorithm as a class if this is helpful.
* Give pupils time to use the MakeCode editor to program their dance sequence animation. Remind pupils to test and debug their programs as they work.
* Remind pupils that if they need to debug their program, they should annotate their algorithm to represent the change. This is most likely to be a change in the time used for a delay.
* If you have access to physical micro:bits, ask pupils to transfer the program to their device.

**Exploring repetition (10 minutes)**

* Use **slide 9** to introduce pupils to repetition, an important concept in writing algorithms and programs. Invite suggestions on how repetition could be used in their algorithms and programs.
* Ask pupils to show on their flowchart algorithm by adding another step, how many times they want their animation to be repeated. Discuss where the block and the arrow from this block should go (**slide 10**).
* Ask pupils to tinker with and explore the blocks in the **loops** menu of the MakeCode editor to find a way to repeat their animation as identified in their algorithm. Encourage them to share their findings with each other until all pupils are able to include repetition in their program (**slide 11**).

**Reviewing repetition (10 minutes)**

* Discuss pupils’ findings when exploring their use of repetition and invite pupils to model their findings on the whole class display screen (**slide 12**).
* Display the [simple dance sequence program](https://makecode.microbit.org/#pub:_Ekrez99KjAbV) (included in the lesson downloads and link on slide 12) using the MakeCode editor and ask pupils to change the number of times it repeats to meet a given criteria (link this to your maths curriculum e.g. repeats given as Roman numerals VI, factors of 18, or multiples of 5 etc.).
* Invite pupils to recap what they have learnt about repetition and using flowchart algorithms in this lesson, using the learning objectives on **slide 13** if you wish.

**Extension ideas:**

* Pupils could create a video in which they perform their dance sequence alongside their animation. They could also create flowchart animations for everyday tasks including repetition, such as cleaning teeth or tying shoelaces.

**Differentiation**

**Support:**

* Pupils may benefit from working in a group led by an adult when constructing algorithms and writing programs. They can be encouraged to focus on just a few steps of their dance sequence.

**Stretch & challenge:**

* Ask pupils to explore the effects that placing the repeat block in different places within their program has on the output.

**Opportunities for assessment:**

* Informal observations of pupils’ understanding of repetition.
* More formal assessment of pupils’ algorithms and programs.