

## Visualizing States of Matter at a Molecular Level

**Subject:** Science

**Level:** Secondary 1 / 2

**Unit:** Model of Matter

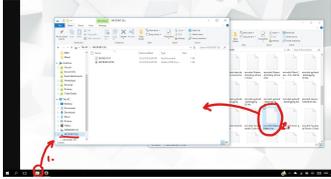
**Topic:** Particulate Nature of Matter

### Summary:

Using the micro:bit's accelerometer and LED matrix, students will be able to visualize the movement of particles in different states by tilting the microbit. And by shaking the microbit vigorously, they simulate supplying energy to matter to change its state.

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| <b>Prior Knowledge:</b> | Matter passes through different states at different temperatures. Energy is required to change the state of matter.   |
| <b>Objectives:</b>      | Allow students to visualize the difference in speed and movement of particles in different states.<br>Give students a hands-on and visual experience in supplying energy to change a state of matter. |
| <b>Resources:</b>       | micro:bit with battery pack and USB connector<br>Computer or phones with Internet access (optional)   |

| Step                             | Teacher Activities  | Purpose  | Resources Needed  |
|----------------------------------|---|--|---|
| <b>Introduction/Pre-activity</b> |   |  |   |
| Step 0                           | Flash the micro:bits with the hex files for this lesson.  |  | microbit-statesofmatter.hex - <a href="http://tk.sg/mbit-statesofmatter">http://tk.sg/mbit-statesofmatter</a> |
| Step 1                           | Recap with students the principals of the Particulate Nature of Matter  | Help students recap the movement of different states of matter   |   |
| Step 2                           | Distribute the micro:bit, USB connector, battery holder and battery to students.  |  | micro:bit<br>USB connector<br>2 X AA batteries<br>Battery holder  |
| Step 3                           | <i>(Optional if students have prior knowledge of the micro:bit)</i><br><br>Explain what is a micro-controller and the basic parts and functions of the micro:bit.<br><br>Show the students the micro:bit introduction video to help them understand what a micro-controller can do. | Help students understand that a micro-controller is like a mini-computer and how to use the basic connections for the micro:bit. | Link to micro:bit introduction video  |

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| <p>Step 4</p>                                    | <p><i>(Highly optional)</i></p> <p>Students to try out coding and setting variables on the micro:bit with the PXT Editor (Blocks mode).</p> <p>(Suggestion: Get the students to try coding their names using a variable text string).</p>  | <p>Students will get a grasp of how to do very basic coding with the PXT platform and help them shape possibilities and ways of using the micro:bit.</p> <p>Coding with variables also helps them understand the concepts they will be exposed to during the activity.</p> | <p>Link to PXT Editor.<br/>www.pxt.microbit.org</p>   |
| <p><b>Lesson development/Main activities</b></p> |  |  |   |
| <p>Step 5</p>                                    | <p>Explain to the students that they will be interacting with the program to customize their own states of matter. By allowing them to change the number of particles (<i>Size</i> - 4 or 9), the number of shakes (<i>Energy</i>) it will take to change the state of matter.</p> <p>The code provided allows them to visualize a block of matter, and shake the microbit to change the state of the matter.</p>  | <p>Give the students an understanding of what the code does, and how it is relevant to the lesson at hand.</p> <p>Allow students to have a sense of ownership over their own “experiment”</p>  |   |
| <p>Step 6</p>                                    | <p><i>(Optional - only if micro:bits were not pre-flashed)</i></p> <p>Ask the students to go to the hyperlink, and download the hex file.</p> <p>Open up file explorer in their taskbar at the bottom of the screen.</p> <p>Connect the micro:bit to the computer using the USB connecter</p> <p>Click and drag the hex file from the Downloads folder into the MICROBIT folder.</p> <p><i>(Optional: to make the activity even more challenging, you can allow students to search for</i></p> | <p>Optional step will create a variety of compounds/elements around the classroom</p>    | <p>Computer with internet access<br/>microbit code</p> <p>microbit-statesofmatter.hex -<br/><a href="http://tk.sg/mbit-statesofmatter">http://tk.sg/mbit-statesofmatter</a></p> |

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|  | <i>different kinds of compounds/elements and their melting/boiling points to model their Size and EnergyRequired variables)</i>   |   |  |
| Step 7   | For Size:<br>Press Button B to toggle between choices 4 and 9.<br>Press button A to select.   |                                       |  |
| Step 8   | For Energy:<br>Press Button B to toggle between choices 1 to 5.<br>Press button A to select.  |                                       |  |
| Step 9   | Let the students explore the different animations produced by shaking or tilting the micro:bit.   | <br>Example of Solid to Liquid change |  |
| Step 10  | Encourage the students to switch their micro:bits with their classmates to explore other choices that their classmates made.  |   |  |
| <b>Closure and consolidation/Post-activity</b> |   |   |  |
| Step 11  | Ask the students to describe the difference between the states of matter and the difference between their programs and their classmates programs.                                   | Consolidate and summarise students' findings on the difference in particulate movement of matter.                       |  |
| Step 12  | Briefly explain that different elements have different melting and boiling points - which mean that they require different amounts of energy to change state.                       |   |  |
|  | If optional challenge was taken, ask a few students to come up to introduce their chosen compound/element and how they changed the EnergyRequired variable to model its properties. | Ensure all students are introduced to the difference in energy required for different compounds/elements                |  |

**Additional Remarks:**

Pre-flashing the micro:bits with the hex files allows you to carry the lesson out in a normal classroom environment without computers. Also reduces classroom time spent on non-essential parts of the lesson.