**SNC1W Resource Collection**

**Title:** Coding a Conductivity Tester using micro:bits

**Course Code:** SNC 1W

| **Topics**  Insulators and Conductors  Electricity  Coding  Skilled Trades | **Timing**  Preparation: 0 min  Lesson: 60 min (introduction lesson) + 60 min (coding and experiment) |
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**Curriculum Expectations**

* **A1.2** apply a scientific experimentation process and associated skills to conduct investigations, making connections between their observations and findings and the scientific concepts they are learning
* **A1.3** apply an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems
* **A1.4** apply coding skills to investigate and to model scientific concepts and relationships
* **A2** Applications, Careers, and Connections - analyse how scientific concepts and processes can be applied in practical ways to address real-world issues and in various careers
* **D2.2** determine the conductivity of various materials by investigating their ability to hold or transfer electric charges

**Introduction**

Teaching students how to identify objects as insulators or conductors provides an excellent opportunity to bring in the Curriculum Expectation topics of coding and the skilled trades. After reviewing the concept of insulators and conductors, students will learn about both the skilled trades career of Powerline Technician and how to use coding and micro:bits to create their own Conductivity Tester. They can then use their Conductivity Tester to determine if objects in their classroom are insulators or conductors.

**Learning Goals**

* Students will learn about insulators and conductors in their environment
* Students will learn about how knowledge of insulators and conductors is important in skilled trade careers like Powerline Technician
* Students will learn what coding is and how it is used to make scientific instruments
* Students will code their own conductivity tester using micro:bits and experimentally determine if materials are insulators or conductors

**Prior Knowledge**

Students may need to review the following concepts:

* How atomic structure relates to electricity
* Insulators and conductors

**Lesson Plan**

| **Description** | **Time** |
| --- | --- |
| Introduction | |
| MINDS ON - Review the concept of Insulators and Conductors   * Start by activating prior knowledge and asking students what they already know about insulators/conductors, whether they can identify any in the classroom, and why they think this knowledge might be useful * Students will use critical thinking to attempt to fill in the blanks on the “1. Insulators and Conductors REVIEW (Fill in the Blank)” sheet. Once students have had sufficient time to attempt this, it can be taken up as a class using the slide deck “2. Insulators and Conductors REVIEW, Skilled Trades, and INTRO to CODING” * Students will then debate which item doesn’t belong in Slide 5 of the slide deck. Students may have many answers depending on what criteria they use * Introduce students to the skilled trades career of Powerline Technician using slides 6-10 | 35 min |
| Content | |
| 1. OPTIONAL: Have students test whether materials are insulators or conductors using a traditional classroom method    1. This can be done using a leaf electroscope, a basic single bulb circuit, or a purchased tester (e.g. Flinn Conductivity Meter)    2. Students will need to understand how the conductivity tester works before using it    3. The activity should be debriefed with the students at then to reinforce what types of materials are insulators versus conductors 2. Introduction to coding (slides 13-18) “2. Insulators and Conductors REVIEW, Skilled Trades, and INTRO to CODING” slide deck    1. Introduce students to the concept of coding and why it is important in modern life 3. Introduction to the micro:bit (slides 19-35)    1. Practicing tutorials    2. Downloading their program    3. Troubleshooting/Debugging   \*If you have 75-minute classes, this is a good place to stop for the day and resume in the next class.   1. Coding their Conductivity Tester    1. Using slide deck “3. How to Code a Conductivity Tester” students will be introduced to using pins    2. Allow students to work independently (in pairs or small groups, depending on the number of micro:bits/computers) and choose a level of code to copy and adjust    3. Once students have a working conductivity tester, they can test objects they have access to in the classroom (e.g. paper, pencil, desk, scissors, etc.) and fill out the “4. MICRO:BITS electrical conductivity testing STUDENT WORKSHEET”   Students can be assessed on their coding by observation and/or conversation at this point | 20 min *[optional]*  5-10 min  20-30 min  40 min |
| Consolidation | |
| * Get students to compare with another group   + Use their combined results to determine what materials are insulators versus conductors   + Compare their experiences with coding and their code * OPTIONAL: If students tested conductivity using another method (leaf electroscope, basic circuit, purchased meter), students can be asked to compare and contrast the two methods and use critical thinking to determine which one is better * As a final consolidation, you can have the class engage in discussion about their experiences coding | 5-10 min  5-10 min |

| **Materials:**   * Computers/Tablets * Laptop/LCD Projector * Handouts: * Other: | **Transferable Skills**   * Critical thinking and problem solving * Innovation, creativity, and entrepreneurship * Self-directed learning * Collaboration * Communication * Global citizenship and sustainability * Digital literacy |
| --- | --- |
| **Instructional Strategies**   * Brainstorming * Think Pair Share * Demonstration * Group Work * Independent Work * Questioning * Class Discussion * Hands On Activity * Other: | **Assessment For/As/Of Learning**   * Conversation * Observation * Homework Check * Notebook Check * Participation * Peer Assessment * Self Assessment * Product * Other: |

**Assessment**

* Formative Assessment should occur throughout the activity as the teacher can circulate and engage students to discuss and improve their code.
  + - This can also occur as peer feedback, by asking students to compare their code with another student and discuss the similarities and differences.
    - Critical Thinking can also be employed to analyse why some codes may be more useful in certain situations than others.
* Summative Assessment by Overall Expectation can be done for the following curriculum:
  + - A1.2 apply a scientific experimentation process and associated skills to conduct investigations, making connections between their observations and findings and the scientific concepts they are learning
    - A1.4 apply coding skills to investigate and to model scientific concepts and relationships
    - D2.2 determine the conductivity of various materials by investigating their ability to hold or transfer electric charges
* Students can be assessed by Observation and/or Conversation according to the following criteria:
  + - Working collaboratively
    - Staying Focused
    - Able to explain their code and what it does
    - Able to make adjustments to code to improve it
    - Persevering through challenges
    - Taking care with the equipment
* Students can also be asked to submit an exit ticket (or journal entry) about their experience with coding, including:
  + - What were you able to make the micro:bit do? Explain your code and how it works.
    - What would you have liked to add to your code?
    - What did you find interesting about doing your program?
    - What did you find difficult about doing your program?
    - What did you do when you got stuck? How did you get unstuck?

**Safety**

* Ensure that students do not forget their basic electricity safety, in that they should not stick anything in a wall outlet
* Remind students frequently that the GND pin should never be connected to the 3V pin of the micro:bit as that will cause damage to the micro:bit

**Equity and Diversity Concerns**

Students will need a computer with internet access and a USB connection to use the micro:bit. If every student does not have access to a laptop with a USB connection, make use of selective grouping to ensure equal access.

* + Students can still use Microsoft MakeCode and see the results of their code on the virtual micro:bit, even if they do not have access to a USB port or a micro:bit.
  + If students have access to a cell phone, some micro:bits are capable of running off of an app available for Android and Apple devices through a Bluetooth connection.
* Once their conductivity testers are built, students can test any objects in the room or on their person. Students can be encouraged to test any object of significance to themselves but should be reminded to respect other students' personal space and property.
* If a student has any type of visual impairment, they may need to be paired with a student to help them with the coding

**Teaching Suggestions/Hints**

* The teacher should experiment with the micro:bit tutorials beforehand to become more familiar with common problems and the relevant coding
* Students unfamiliar with coding should be encouraged to copy the recommended code exactly (like following a lab procedure or a recipe), while more experienced students can be encouraged to experiment with modifying and extending the suggested code
* Some students may already be familiar with coding and can switch between the block code and Python or JavaScript while using MakeCode

**Next Steps/Extensions**

* Students can be asked to research related skilled trades such as Power Line Technician
  + This can include basic job information (salary, job tasks, years of experience, etc.) and also how knowledge of insulators and conductors is relevant to their job
  + Summative Assessment could be included by assessing expectation A2. *[Applications, Careers, and Connections - analyse how scientific concepts and processes can be applied in practical ways to address real-world issues and in various careers]*
* Students can be asked to research how various careers use conductivity testers and why (e.g. electricians)
* Students can explore other careers related to electrical engineering and manufacturing of electronic devices using the Let’s Talk Science Career Profiles website [Example/ <https://letstalkscience.ca/careers/jyoti-rani>]

**Additional Resources**

* Powerline Technician - Skilled Trades Ontario
  + <https://www.skilledtradesontario.ca/trade-information/powerline-technician/>

* Let’s Talk Science Career Profiles
  + <https://letstalkscience.ca/careers/jyoti-rani>
  + <https://letstalkscience.ca/careers/dong-an>