Class 6

Lesson 6.4

Electricity and Circuits- Chapter 12

Parameters	Description	Note for teachers
Chapter Covered	Chapter 12: Electricity and Circuits	This lesson plan can be taken from the Section 12.3- *Electric circuit* and beyond, from Chapter 13: Electricity, NCERT, Science Textbook of Class VI
Name of the Book	NCERT, Science Textbook for Class VI	
Learning Objectives	This chapter imparts the foundational knowledge about electricity. Through this lesson plan, learners will be introduced to the basics of an electric circuit and to differentiate between good and poor conductors. To enable learners to: **Scholastic:** **Stage 1: Conceptualization** ● Identify different types of electrical components and their symbols. ● Differentiate between series and parallel circuits. ● Differentiate between good and poor conductors of electricity. **AI + Tinkering:** **Stage 2: Apply Design Thinking framework** ● To instigate their understanding on parallel And serial wiring ● To understand the basics of an electric circuit ● Develop an understanding towards Recognizing good and poor conductors (insulators) **Stage 3: Hands-on experience on developing paper circuit activity** ● Developing an electric circuit with essential elements. ● Experiment various types of arrangements to create a closed circuit (serial or parallel wiring) **Stage 4: Introduction to an Image classification tool for classifying material as good or poor conductors of electricity** ● Leveraging Artificial Intelligence to distinguish between conductors and insulators. ● Training an AI model with image data. ● Basics of Scratch coding. ● Integration of Scratch with AI models.	
Time Required	4 periods of 45 minutes each	

Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular classroom arrangement. ● Activity Sessions – Flexible (for group/pair work).	
Materials Required	● Smart Class setup ● Whiteboard & Marker ● Computers with Webcam ● Good internet connectivity **Paper Circuit Activity:** ● Copper Tapes ● A4 Sheets ● Button Cells ● LEDs ● Stationery (Sketch pens, Cello Tape, etc.)	
Pre – Preparation Activities	Teacher to keep the following resources ready before the session: ● Circuit diagram - Simple circuits. https://www.youtube.com/watch?v=j0zf-otH3cY ● Open and closed circuit and energy generation. https://www.youtube.com/watch?v=DwHlhDrqcuw ● Science behind glowing of bulbs. https://www.youtube.com/watch?v=rp09r-Z1SmY ● Working of an electrical switch. https://www.youtube.com/watch?v=x78BU7-LfgY ● The Teacher goes through the following tutorial on Paper Circuit activity before its execution https://www.instructables.com/Paper-Circuits/ ***The Teacher shall prepare an electrical circuit (incandescent bulb, switch, crock wires, battery etc.) and give a live demonstration in the class.***	
Previous Knowledge	Basic knowledge of the use of electricity.	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** The Teacher will initiate the session by asking the generic meaning of a circuit. Further the Teacher will build up the session by: ● Explaining electrical circuit ● Showing these two videos to explain the basics of an electrical components, open and closed electrical circuit and glowing of a bulb: ○ Circuit diagram - Simple circuits https://www.youtube.com/watch?v=j0zf-otH3cY ○ Open and closed circuit and energy generation https://www.youtube.com/watch?v=DwHlhDrqcuw ● Explain the science behind glowing of bulbs https://www.youtube.com/watch?v=rp09r-Z1SmY ● The Teacher will cover the working of an electrical switch. https://www.youtube.com/watch?v=x78BU7-LfgY	

	Contextualization: **AI and Tinkering**: **Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* to the following scenario (Subject Teacher and ATL In-charge)** Scenario: *Ram is 12 years old who lives in Chandigarh. It was during the biggest festival, Diwali, that Ram was helping his father, Bhaskar, to decorate the house with lights. He unintentionally stepped on and broke one of the bulbs from the fairy light set. Later, he apologized to his father about the situation. Ram was asked by Bhaskar to plug in the fairy lights and check whether it is still functional or not. As and when Ram touched the electric socket, he felt a mild electric shock. Baskar noticed that Ram is barefoot and instantly advised him to wear his rubber slippers. At first, Ram was hesitant to touch the electric socket, but his father assured him that he won't get hurt.* *Upon checking, the fairy lights worked perfectly fine, except the bulb that was left broken. At the same time, Ram also noticed the two wires running in parallel and connecting the bulbs of the fairy lights. He wanted to know the reason behind using two wires in fairy lights, although only one wire is seen in other devices, such as the hairdryer or electric iron. Ram wondered what made the difference.* The Teacher will now apply the design thinking framework to the above scenario. **Empathize**: Ask learners to reflect on the above scenario and brainstorm the aspects and questions they need to raise to find out about the exact situation of the problem. They can come up with the following points: 1. What was Ram doing with lights? 2. Should Bhaskar have allowed Ram to use the electric socket and fairy lights? 3. What is the wire of the fairy light made up of? 4. In general, what could be the possible reason behind the un-operational bulb in a fairy light? 5. How does plugging only two wires in the electric socket lights up multiple bulbs in a fairy light? 6. What does 'being barefoot' have anything to do with electricity? 7. Was the electric shock felt by Ram 'fatal'? 8. The second time, why didn't Ram feel the shock? 9. Which material is used to connect bulbs in a fairy light? 10. Why do hair dryers and electric iron have only one wire? (Hint: there are two wires concealed within an insulating polymer cladding) **Define**: Learners to understand the basics of an electric circuit and develop an understanding towards recognizing good and poor conductors (insulators). **Ideate:** Learners identify various methods to develop an electric circuit. Teacher introduces them to the concept of Paper Circuits. After that, they are engaged in a brainstorming session to identify methods to identify conductors and insulators. **Stage 3: Hands-on experience on developing paper circuit activity (Subject teacher and ATL In-charge)** In the paper circuit activity, learners are provided with basic materials such as Copper Tape, LEDs and a Button Cell.

3.1 The ATL teacher shows them how to create a paper circuit with a switch made of copper tape.

3.2 Post this, learners use their own creativity to create their own circuits.

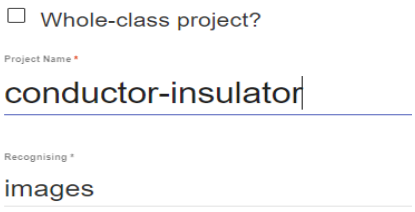
Stage 4: Introduction to an Image classification tool for classifying material as good or poor conductors of electricity (Subject Teacher and AI Faculty)

After building the paper circuits, learners develop an AI algorithm to identify conductors and insulators through images. Here are the steps to follow:

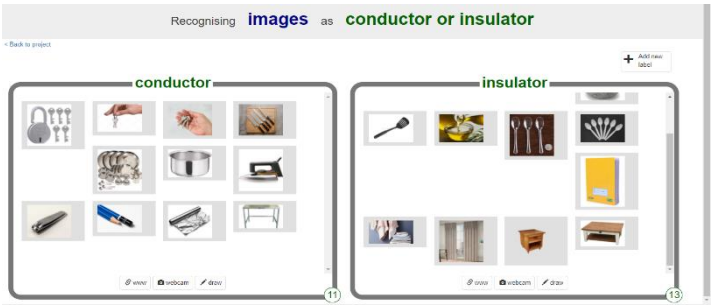
4.1 Go to https://machinelearningforkids.co.uk.

4.2 Create a new project by clicking on the "Add a new project" button.

4.3 Give an appropriate name for the project, and set it to recognize images.

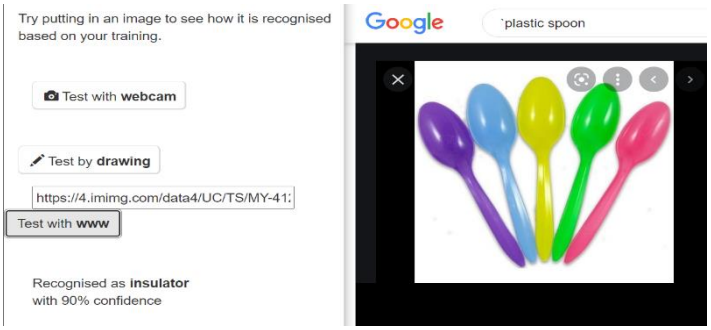


4.4 Add two labels named conductors and insulators and start adding images of household items to the respective labels



4.5 Now to train the model, go to the learn and test section of the project. Simply click on the "Train new machine learning model" to start the process.

4.6 After training, test whether the model is working or not by inserting a test image from the internet. Right-click on the image you found online and select the "Copy image address" option. Then paste it in the text box on the webpage as shown below. And then click on the "Test with www" button:



4.7 The AI model to classify objects as conductors and insulators is now ready.

Stage 5: Introduction to Scratch coding for classifying good and poor conductors (Subject Teacher & AI Faculty)

Empathize: Learners are asked to answer the following questions:

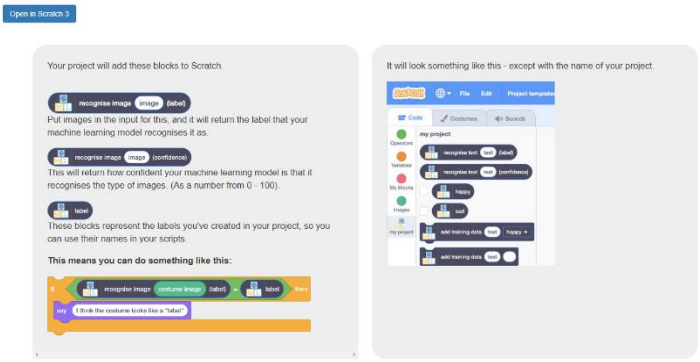
- Is the AI solution user-friendly?

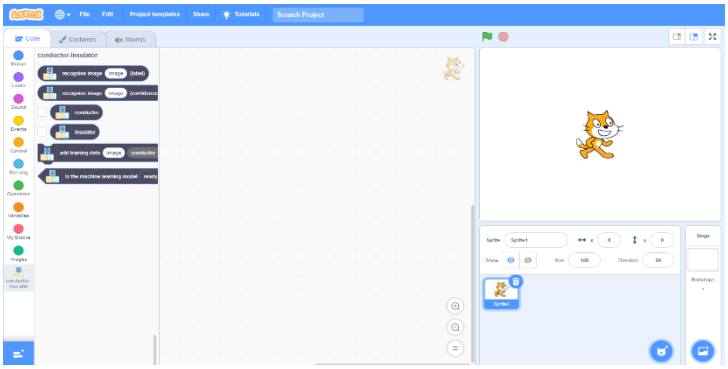
Define: Learners brainstorm on ways in which the AI model could be made more user-friendly with Scratch coding.

Ideate: Learners are introduced to the concept of Scratch coding.

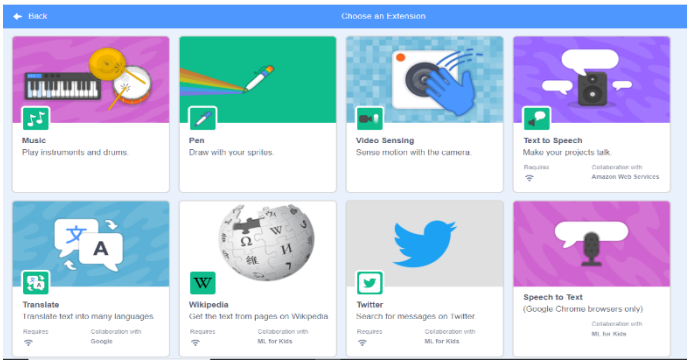
Use Scratch coding with AI Model Here are the steps to use Scratch coding with the AI model we created earlier

5.1 Go to the **Make** section of the project, and then click on **Open in Scratch** This will open a special version of Scratch with the plugin for our machine learning model already included with the standard Scratch blocks.



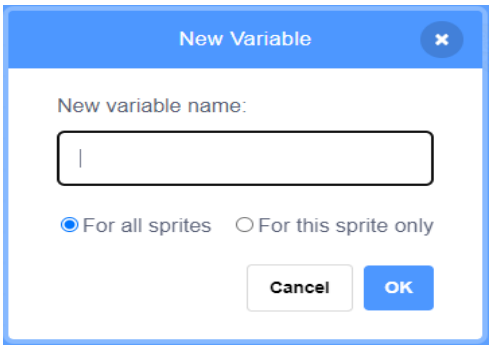


5.2 To sense the video feed, click on the blue square in the bottom left of the screen. When you click on it, you will see something like this:

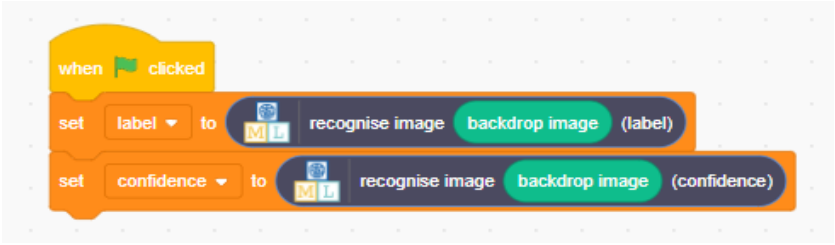


5.3 From these extensions, choose the **Video Sensing** extension. As soon as you include that extension, the background of the program starts showing your webcam's video.

5.4 Create two new variables by going to the **Variables** section and clicking on **Make a new variable**:

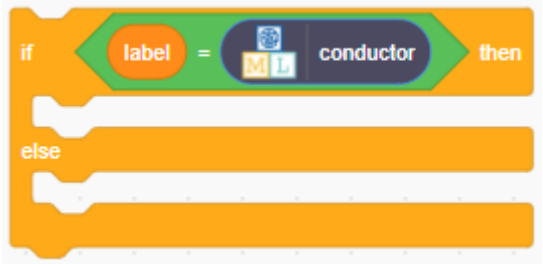


5.5 Then we will attach the following blocks from **Events**, **Variables**, **Machine Learning plugin** and the **Images** section:



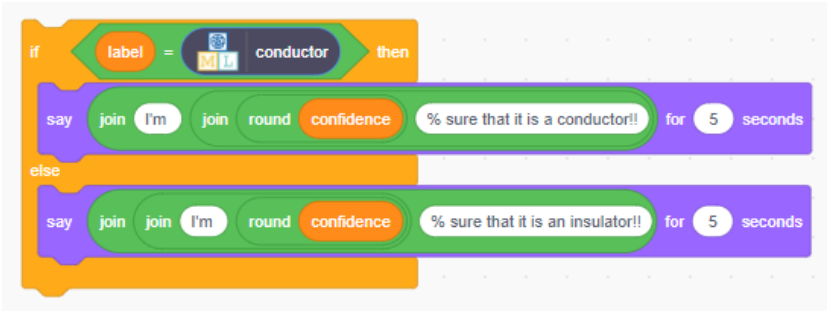
5.6 Create two variables named 'label' and 'confidence'. 'label' will store whether the observed image is identified as a conductor or insulator and 'confidence' will store the percentage of confidence that the AI model has for the prediction that it has generated.

5.7 Next, create these set of blocks to be attached to the ones created previously:

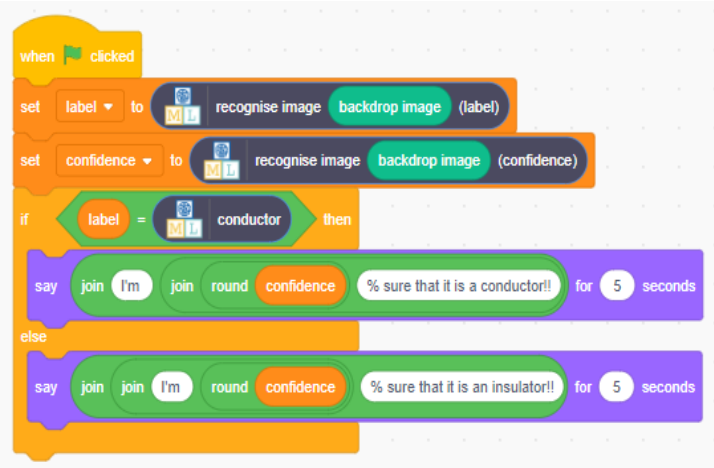


5.8 We will use the blocks from **Control, Variables, Operators,** and the **Machine Learning model** to create the above arrangement. This combination will be able to do different things based on whether the value of "label" is conductor or not.

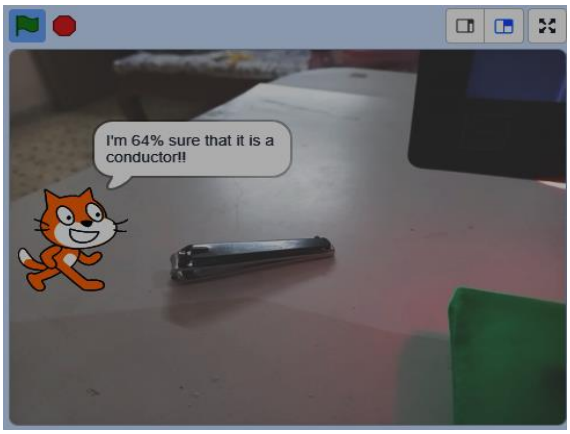
5.9 Now, attach some more blocks to create some output upon detection of the object:



5.10 After everything is in place, this is what it looks like:

<table>
<tr>
<td></td>
<td>


5.11 The Scratch code with coloured blocks can be accessed here: https://bit.ly/cl6ch12sc and this is the expected outcome of the project:



Learners may now test this AI model and try to make the interface more interesting by adding sounds and animations.
</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>
The learners will be able to

Relate the glowing of a bulb with resistance.
Draw labelled electrical circuits.
Apply the learning of electricity in day-to-day life.
Compare the working and benefits of parallel circuits to serial circuits.
Understand how to develop an AI algorithm to work with images.
Develop an understanding towards scratch coding.
Understand how to acquire data and train and AI model.
Integrate Scratch coding with AI algorithms.
Create a machine learning model capable of distinguishing images.
Differentiate between good and poor conductors of electricity.

</td>
</tr>
<tr>
<td>Glossary</td>
<td>

Scratch is the world's largest coding community for children and a coding language with a simple visual interface that allows young people to create digital stories, games, and animations.
Machine learning is a subfield of artificial intelligence, which is broadly defined as the capability of a machine to imitate intelligent human behaviour. Artificial intelligence systems are used to perform complex tasks in a way that is similar to how humans solve problems.

</td>
</tr>
</table>

	• Machine Learning for Kids: This free tool introduces machine learning by providing hands-on experiences for training machine learning systems and building things with them. It provides an easy-to-use guided environment for training machine learning models to recognize text, numbers, images, or sounds. This builds on existing efforts to introduce and teach coding to children, by adding these models to educational coding platforms Scratch and App Inventor and helping children create projects and build games with the machine learning models they train.
Skill outcomes	**Tech skill** • Digital learning • Data gathering • Model optimization **Design thinking** • Ideation • Innovation • Prototyping **AI domain** • AI for Computer Vision **Physical computing** • Basic electrical and electronics. • Circuit building **Interpersonal skill** • Collaboration • Team Work **Intrapersonal skill** • Observation skill • Organizational Skill