Class 7

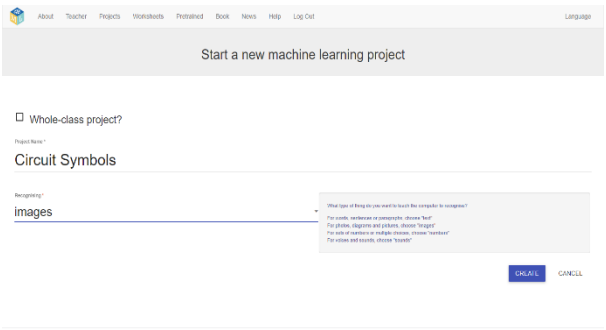
Lesson 7.1

Electric Current and its Effects - Chapter 14

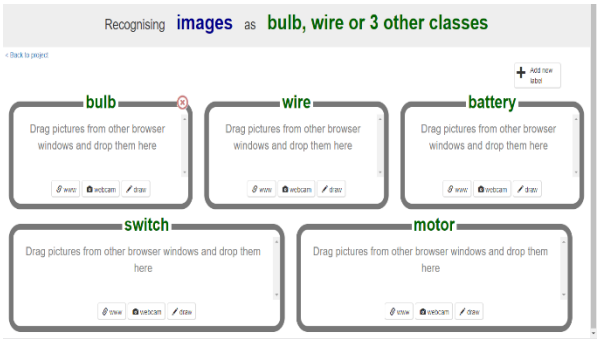
Parameters	Description	Note for teachers
Chapter Covered	Chapter 14: Electric Current and its Effects	This Lesson Plan must be taken after teaching the 'Section: 14.4 – Electromagnet from Chapter 14: Electric Current and its Effects
Name of the Book	NCERT, Science Textbook for Class VII	
Learning Objectives	This chapter talks about the various effects exhibited when electricity flows through a conductor. One such effects is creation of magnetic field around the conductor, that are used in making Electromagnets. This lesson plan will help the learners to understand the design as well as the various parameters required to build an electromagnet. To enable learners to **Scholastic:** **Stage 1: Conceptualization** ● Identify the basic electrical symbols used ● List some everyday uses for electromagnets ● Understand the correlation between magnetism and electricity **AI Tinkering:** **Stage 2: Contextualization upon introduction to electric symbol classification and identification, and understanding magnetic effects of electricity using PHET simulations** ● Create a machine learning algorithm that can recognize electrical schematic symbols ● Simulate an electrical circuit ● Understand how solenoids work and how to change the magnetic properties by changing some parameters **Stage 3: Building a perpetual swing toy using DIY construction kits based on electromagnetism** ● Hands-on experience with creating solenoids/electromagnets ● Independently create a closed circuit	

	● Get a basic idea on relation between the number of turns in a copper coil with the strength of the produced magnetic field. ● Verify the phet simulation with the real self-created electrical circuit ● Draw conclusions whether the phet simulations correlated with the handmade electrical circuit	
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)	
Material Required	● Smart Class setup ● White board and marker ● Computer with webcam ● Good internet connectivity For scholastic activity: ● Battery ● Wire ● Iron nail ● Paper clips ● Tape ● Safety Pins For DIY Swing activity: ● Enamelled copper wire ● Permanent magnet ● 9V battery ● Connecting wires ● Cardboard ● Scissors ● Battery connectors ● Tape	
Pre – Preparation Activities	Teacher to keep the following links ready before the session: ● Thermal effect of electricity https://www.youtube.com/watch?v=rp09r-Z1SmY ● How to make an electromagnet https://www.youtube.com/watch?v=na_FpTXLFa8&t=15s&ab_channel=GoodStuffExperiments ● Teacher may use the following links during the session for better understanding of concepts: o Circuit diagram - Simple circuits https://www.youtube.com/watch?v=j0zf-otH3cY o Open and closed circuit and energy generation https://www.youtube.com/watch?v=DwHIhDrqcuw o Working of an electrical switch https://www.youtube.com/watch?v=x78BU7-LfgY o Demo on electromagnets for the teacher https://www.youtube.com/watch?v=V-Gus-qIT74	

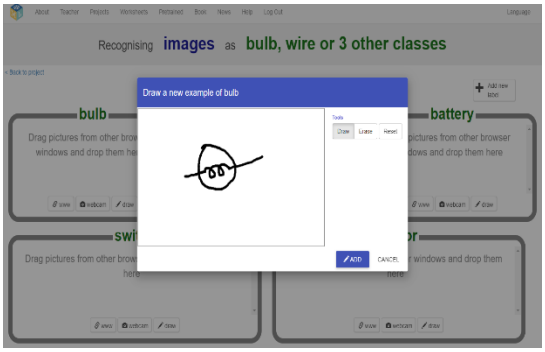
	○ How to make an electromagnetic swing https://www.youtube.com/watch?v=9ZwOvOVlljg ● Teacher explores the following online tools before the session: ○ Machine Learning for Kids www.machinelearningforkids.co.uk ○ PHET Simulations on electromagnetism https://phet.colorado.edu/en/simulations/magnets-and-electromagnets ● Teacher understands and develops an electromagnetic swing	
Previous Knowledge	Basic understanding of electricity and circuits	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** For this activity, the learners must be given a live demonstration on the topics: 1.1 Thermal effect: Glowing of incandescent bulbs and heating filaments https://www.youtube.com/watch?v=rp09r-Z1SmY **1.2** Electromagnetism: ○ Teacher will perform an activity using a 3-inch-long iron nail and try lifting small paper clips or safety pins by bringing them in the vicinity of the iron nail. ○ Next, the Teacher will wrap a copper wire around the 3-inch-long nail and then connect the ends of the copper wire (the starting piece and ending piece) with the battery terminals. Again, the Teacher will try lifting small paper clips or safety pins with the copper wire and iron nail arrangement. ○ This time, the learners will notice that the properties of the iron nail have changed, and the battery has imparted some invisible attractive force to the nail. The object has temporarily turned magnetic under the effect of electricity. https://www.youtube.com/watch?v=na_FpTXLFa8&t=15s&ab_channel=GoodStuffExperiments **Contextualization: AI and Tinkering:** Students are presented with a problem statement *"Rahul wants to develop an electromagnetic swing. He needs to learn about electric symbol classification understanding magnetic effects of electricity using PHET simulations"* **Stage 2: Introduction to electric symbol classification and identification and understanding magnetic effects of electricity using PHET simulations (Subject Teacher and AI Faculty)** For this activity, learners will develop a machine learning program that recognizes different circuit symbols. Here are the steps to follow: **2.1** Go to www.machinelearningforkids.co.uk and start a new project that can recognize images	



2.2 Create new labels for identifying circuit symbols like battery, bulb, switch, wire and motor. Learners may add more labels if needed.



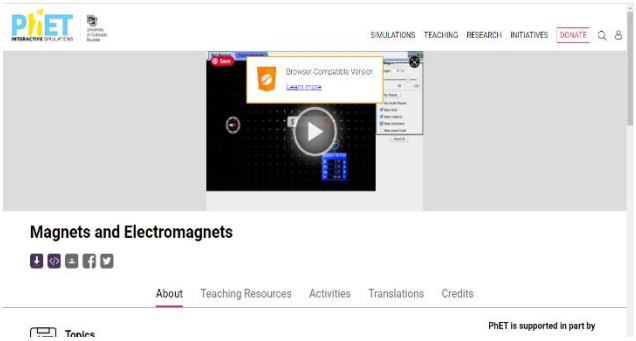
2.3 Now, learners put drawings or images of the electrical symbol for each component they added as label. Add at least 10 samples per label.



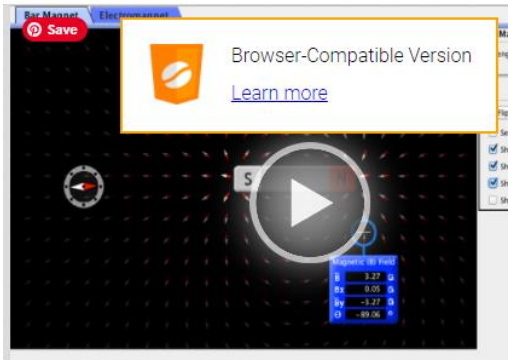
2.4 After adding 10 different images for each label, train the model by going to "Learn and Test" and clicking on the "train new machine learning model".

2.5 After the new model has been created, test the model by choosing the "Test by drawing" button. This opens a new window where you can draw the symbol and test the model with it.

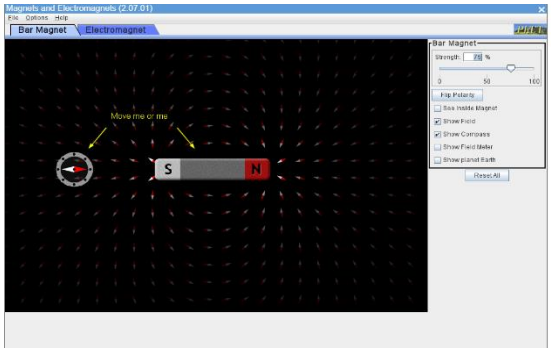
2.6 At this stage, learners explore an online simulation software to understand the dynamics of electromagnetism. Here's how: Visit https://phet.colorado.edu/en/simulations/magnets-and-electromagnets



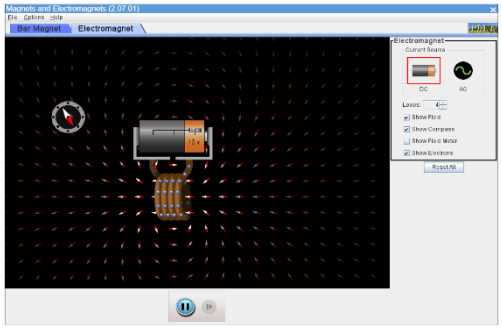
2.7 To run the simulation in the browser, click on the Play button



2.8 The following window would open by clicking on the Play button



2.9 Go to the electromagnet tab



1.10 Keep adjusting different parameters and observe their effects in the simulation.

The Teacher can ask learners to express the relation between the number of turns in the coil with the strength of the magnetic field produced in the form of artwork.

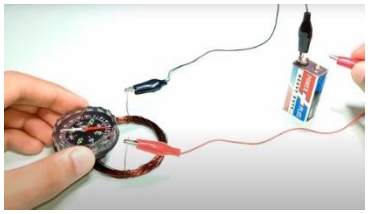
Stage 3: Building a perpetual swing toy using DIY construction kits and applying electromagnetic concept (Subject teacher and ATL in charge)

In this activity, we will be making an electromagnetic swing using enamelled copper wire, also known as magnet wire, a Permanent magnet, a 9V battery and some hardware. You can also watch the following video for reference: https://www.youtube.com/watch?v=9ZwOvOVlljg

3.1 Wrap the wire around a cylindrical object like a metal can or a cardboard tube to make a coil of at least 30 turns, leaving about two inches of wire on each end

3.2 Use a cutter to remove the enamel coating on the wire from the ends so that it can be connected with other wires

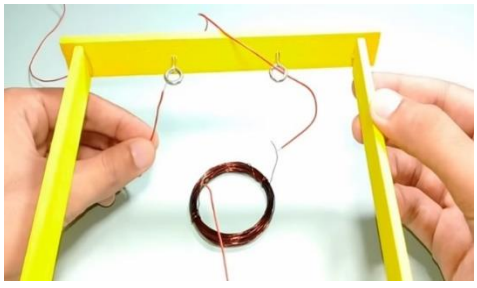
3.3 Now, connect the coil to the battery while keeping a compass very close to the coil. As soon as you connect the coil to the battery, you should notice a deflection in the compass



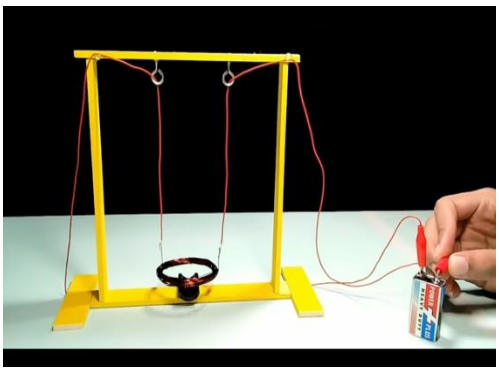
3.4 Now, create a frame of the swing

3.5 Now, connect two wires of 40 cm length on each end of the copper coil

3.6 Next, thread the wires through the hooks in the frame to make the swing



3.7 After this, attach some permanent magnets to the middle of the base

	 3.8 It is now time to test the system! Connect the coil with the battery and then observe what happens. If it gets attracted to the permanent magnet, we need to reverse the connections of the coil with the battery. Otherwise, the swing should move back and forth every time the coil is powered by the battery  3.9 Learners can improvise the system by: ○ Using more or stronger magnets ○ Increasing the number of turns ○ Adding an Iron core to the coil ○ Making the coil stationery and magnet as a part of the swing ○ Using a more powerful battery The teacher will ask the learners to compare the PHet simulation predictions with the actual experiment they performed, and validate or dismiss the predictions.
Learning Outcomes	The learners will be able to ● Identify magnetism as one effect of electricity. ● Witness how simulation software work. ● Visualize the electromagnetism effect and understand it better by working the dynamics of it. ● Understand and visualize the magnetic effect of electric current. ● Develop a better understanding towards the different types of electrical symbols used to represent electric components. ● Construct their own electromagnets and tweak their properties.
Glossary	● 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. ● 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 like how humans solve problems.

Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking **Mathematical and quantitative skills** • Statistical analytics • Graphical inference **Design thinking** • Ideation • Innovation • Prototyping **AI domain** • AI for Computer Vision **Interpersonal skill** • Collaboration **Physical computing** • Basic electrical and electronics. • Circuit building **Intrapersonal skill** • Observation skill • Persuasion • Effective Communication