NITI Aayog

ATAL INNOVATION MISSION

intel

AIoT Integration in Curriculum

Acknowledgments

Advisory & Creative Inputs

- Ms. Nidhi Chhibber, IAS, Chairperson, Central Board of Secondary Education
- Dr. Chintan Vaishnav, Mission Director, Atal Innovation Mission, NITI Aayog
- Dr. Biswajit Saha, Director, Skills Education, Central Board of Secondary Education
- Ms. Shweta Khurana, Senior Director, Global Government Affairs, Intel India

Editorial and Creative Inputs

- Ms. Deepali Upadhyay, Program Director, Atal Innovation Mission, NITI Aayog
- Ms. Sarita Manuja, Educational Consultant & Program Director, NHES
- Ms. Saloni Singhal, Program Manager – Intel Digital Readiness Programs, APJ

Value adder, Curator and Co-ordinator

- Mr. Ravinder Pal Singh, Joint Secretary, Department of Skill Education, Central Board of Secondary Education
- Ms, Vishnu Priya Bijapur, Innovation Lead, AIM, NITI Aayog

Content Inputs Team

- Mr. Shubham Gupta, Innovation Lead, AIM, NITI Aayog
- Mr. Prateek Deshmukh, Innovation Lead, AIM, NITI Aayog
- Ms. Tanvi Misra, Young Professional, AIM, NITI Aayog
- Mr. Suman Pandit, Young Professional, AIM, NITI Aayog

Content Preparation Team

- Dr. Phalguni Tewari Kumar, Stepping Stones Sr. Sec. School
- Ms. Mehreen Shamim, Delhi Public School, Bangalore East
- Ms. Dolly Dhawan, G D Salwan Public School, New Delhi
- Ms. Shelly Bakshi, The Olive School, Thol, Kurukshetra
- Ms. Leelambika Srinivasan, Air Force School, Bangalore
- Ms. Soumya Iyer, D A V Public School, Pune
- Ms. Madhubala, JR Dani Girls Sr Secondary School, Raipur
- Mr. Abhijit Mondal, Salwan Public School, New Delhi
- Mr. Sohil Patel, Director, Jayso Foundation
- Intel® AI for Youth Coaches

Message from Dr Chintan Vaishnav
Mission Director
Atal Innovation Mission, NITI Aayog

Our future generation is the shaper of our world. They will be the drivers of innovation and discovery and will set India's pace as global powerhouse.

Atal Tinkering Lab is Atal Innovation Mission (AIM), NITI Aayog's flagship initiative to promote innovation and creativity. ATLs are open innovation makerspaces where young minds give shape to their ideas through hands on do-it-yourself mode. The program has become a national movement that is revolutionising the Education Ecosystem of India. The goals and vision of the ATL movement tie in beautifully with the National Education Policy 2020 (NEP) and play a pivotal role in implementing the 'Experiential and Project-Based Learning' model in India. The Atal Tinkering Labs are challenging our incumbent education system in the schools. When I meet students from different quarters of the country come up with innovations regardless of how remote and resource-constrained they may be, I am filled with much hope for the future of our country.

AIM, NITI Aayog is now partnering with CBSE and Intel to make 'Tinkering' a part of the formal pedagogy. I congratulate AIM, CBSE and Intel teams for conceptualizing this program, and this manual that will take you through the methodologies to make 'Tinkering' a part of the school curriculum and connect it with the subjects and the emerging technologies of Artificial Intelligence.

Artificial intelligence is gaining spotlight across applications in our personal and professional lives. Using this book, students will get a deep understanding of AI, access to AI-powered tools and the ability to create solutions with AI and innovate for the future. The National Education Policy (NEP) 2020 has included all the tech-related features focussing on artificial intelligence the most. AI is included in the education curriculum. This new initiative of AI-ATL integration in school curriculum will help in achieving the goal of NEP of developing 21st-century skills in students and preparing them for the fourth Industrial Revolution.

Way forward from Dr Biswajit Saha
Director
Skills Education, Central Board of Secondary Education

National Education Policy aims at developing talent for the Fourth Industrial Revolution by preparing students for an economy that is driven by emerging technologies. To achieve this, many innovative programs have been introduced in the schools like the establishment of ATLs (Atal Tinkering Labs) by NITI Aayog and introduction of Artificial Intelligence curriculum in schools and integrating AI in subjects as a multidisciplinary approach by CBSE, in collaboration with Intel.

NITI Aayog and CBSE have collaborated with Intel to bring all these initiatives together as AIoT Integration - to enhance future skills and learning outcomes of the students by integrating Artificial Intelligence and Tinkering with subject pedagogies and making it part of the formal education system.

AIoT is transformational and mutually beneficial for both AI and Internet of Things (IoT), as AI adds value to IoT through machine learning capabilities and improved decision-making processes, while IoT adds value to AI through connectivity, signalling and data exchange. AIoT reinforces the learning outcomes of tinkering – fostering curiosity, creativity, and imagination in young minds; and inculcating skills to use these technologies impactfully and responsibly in a technology-led environment.

We look forward to the effective implementation of the program and help promote better learning outcomes and inculcate relevant future skills. Currently the program is going to be initiated in the schools which have operational Atal Tinkering Labs and have opted for AI as a vocational subject. These pioneer schools would be the hubs of innovation and are intended to be the model for rest of the school communities in the country.

Foreword by Ms. Shweta Khurana
Senior Director - Asia Pacific Japan, Government Partnerships & Initiatives
Global Government Affairs Group, Intel

Emerging technologies like Artificial Intelligence (AI), Blockchain, IoT (Internet of Things), and 5G are fundamentally altering the landscape and reshaping the world. AI is the next inflection of computing technology that will deliver profound, pervasive benefits across our societies.

At Intel, our purpose is to create world-changing technology that improves the life of every person on the planet. We strive to create a more responsible, inclusive, and sustainable future through our technologies and collective actions. We are collaborating with government organizations for enabling students with AI skills and empowering them to create AI-based indigenous social impact solutions for local and global problems.

Taking this journey ahead, we are happy to collaborate with Atal Innovation Mission NITI Aayog and CBSE Ministry of Education to build relevant skills to converge AI and IoT as AIoT (Artificial Intelligence of Things); and integrate ithe t with pedagogy to support better learning outcomes. "The convergence of AI and IoT will redefine the future of industrial automation. It is set to lead the In,dustry 4.0 revolution" 1

This initiative can potentially expand the usage and impact of tinkering labs and the AI curriculum in schools. The AIoT fusion is increasingly becoming more mainstream as it continues to push the boundaries of data processing and intelligent learning, which can empothe wer the next generation with skills relevant to future of work.

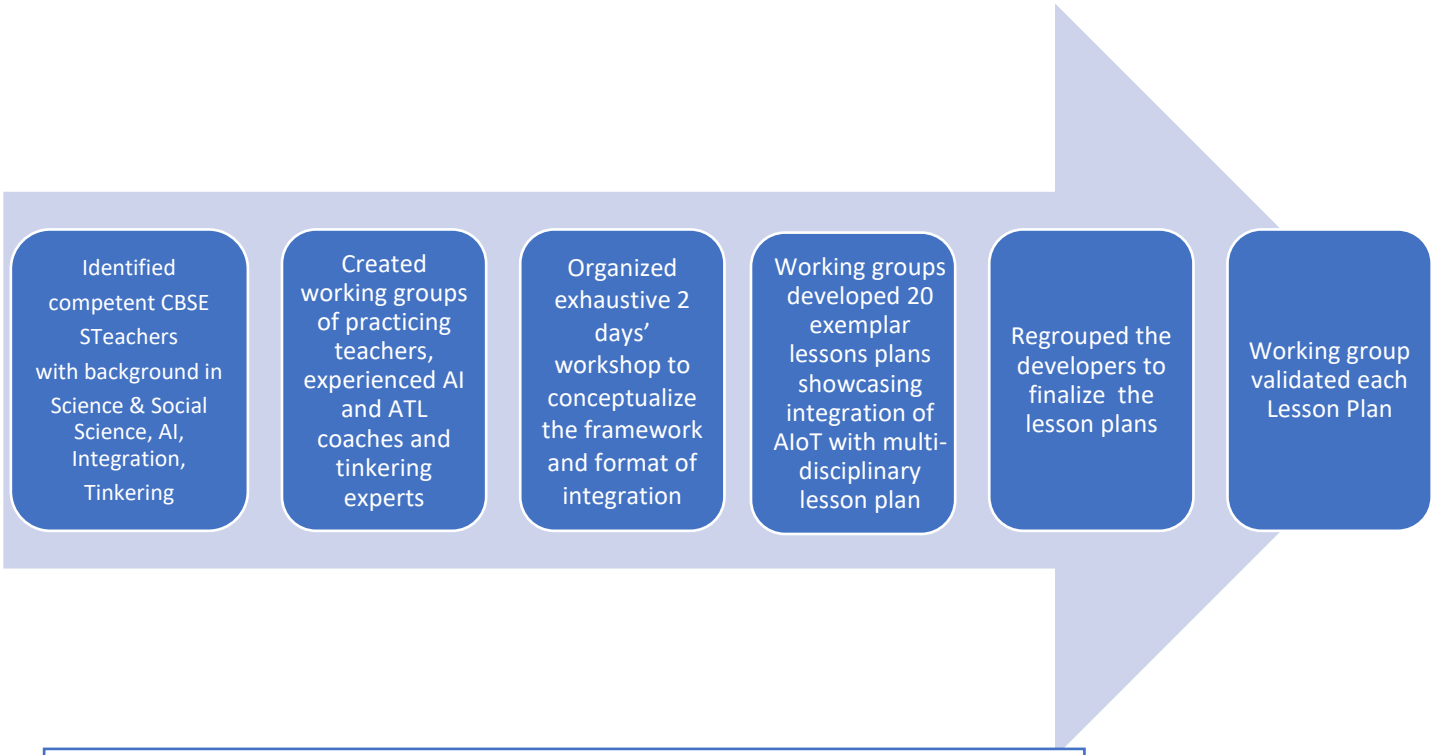
[1] https://www.forbes.com/sites/janakirammsv/2019/08/12/why-aiot-is-emerging-as-the-future-of-industry-40/?sh=325512a3619b

About the Book

This manual aims to provide principals and teachers with content for AI and Tinkering integration with subjects. The content is not completely exhaustive; it provides direction to teachers to develop their lesson plans in collaboration with the AI and Tinkering lab teachers. It is recommended that teachers explore these exemplar lesson plans, develop their lesson plans and implement them in the classroom.

Stages of development of the document

A working group of practicing teachers, education pedagogists, experienced ATL and AI coaches were formulated and the development of this document underwent the following stages.



Disclaimer: Individual lesson plans have been created and edited by the contributing teachers as per their respective beliefs and understanding. The originality of their perception has been maintained while curating this document

Table of Contents

Index of AIoT Integrated Lesson Plans

1. Chapter 1 – AIoT Integration in Curriculum - About the Program

1.1. Atal Innovation Mission and Atal Tinkering Labs initiative

Atal Innovation Mission (AIM) is the Government of India's initiative to create and promote a culture of innovation and entrepreneurship among the students and youth of the country. Under AIM, NITI Aayog established Atal Tinkering Laboratories (ATL) with support from Intel India in schools where students develop solutions to real-world problems through hands-on, do-it-yourself mode and learn innovation skills. ATL aims to provide opportunities to the students to conduct hands-on experiments and work with the latest technologies, and develop solutions for real-world problems.

1.2. Introduction of Artificial Intelligence Curriculum by CBSE

CBSE offers various skill subjects at the secondary and senior secondary level to upgrade the skills of students and to make them aware of various career options. As India's AI Strategy identifies that AI will play a significant role in inclusive social development and identifies the importance of skill-based education, CBSE introduced Artificial Intelligence as an elective skill subject for Class IX and X from the Session 2019-2020 onwards. Artificial Intelligence Curriculum was curated by CBSE with support from Intel India and aims at developing the learner's mindset and skills set towards AI and how it is applied for problem-solving, creative thinking, and critically analyzing data.

1.3. AIoT Integration in Curriculum Program – Joint Initiative of CBSE, NITI Aayog and Intel India

AIoT is transformational and mutually beneficial for AI and Internet of Things (IoT). AI adds value to IoT through machine learning capabilities and improved decision-making processes, while IoT adds value to AI through connectivity, signalling and data exchange. AIoT reinforces the learning outcomes of tinkering – fostering curiosity, creativity, and imagination in young minds; and inculcating skills to use these technologies impactfully and responsibly in a technology-led environment. NITI Aayog and CBSE are working in partnership with Intel India to bring all these initiatives under one holistic transformational program - **AIoT Integration in Curriculum** to augment pedagogical learning outcomes and future skills of the students by integrating AI and Tinkering with formal curricular concepts.

- ### Rational for AIoT Integrating in Curriculum program

  The need of a holistic initiative arose because it was felt by all stakeholders that success of such initiative requires more than mere setting up of a physical space in schools. The success of this program depends on how efficiently and effectively all the people in the ecosystem at school and outside are involved to fulfil these expectations. Hence, there is a need to align the teachers across school disciplines engage themselves with the basic elements on which AIoT works. AI and Tinkering should not just remain limited to the four walls of the labs, there must be AIoT ecosystem supported by all the teachers teaching a child in the school.

- ### Objectives of the program are

  - To nurture spirit of innovation, invention & discovery in youth and develop a design mindset
  - To provide opportunities to students to demystify tinkering while using AI
  - To democratize skills of tinkering and AI and make it accessible for all .
  - To enhance the learning outcomes of the students and making them future-ready.

2. Chapter 2: Introduction of Tinkering and Artificial Intelligence

2.1. Introduction to Tinkering and stages of Tinkering

Tinkering is to find innovative and creative solutions to problems that may be local or global. It develops the aptitude to explore and experiment. Students get involved with technology i.e., experimenting with various technology tools like electronics and robotics to understand their potential and use them to find solutions for local and global problems.

Stages of Tinkering – Following are the stages of tinkering

1. Design Thinking

In Design Thinking students are encouraged to explore real-world problems and find solutions for them. Design Thinking is a framework that allows them to think and brainstorm about the various aspects of the problem and its possible solutions of it.

Stages of Design Thinking

The Design Thinking process can be defined through five distinct stages: empathize, define, ideate, prototype, and test.

Stage 1 : Empathize

Empathy is the ability to put yourself in someone else's shoes to start "seeing" things through his/her eyes. In this stage students see themselves in the user's shoes and empathize by seeing, thinking, and feeling like the person who is facing the problem.

Stage 2: Define

In this stage students define the identified problem in detail. The Point of View (POV) statement (the user, need, and insight) helps transition into the defined stage.

Stage 3: Ideate

Using different ideation techniques, students brainstorm solutions to the problems/challenges and from the pool of ideas, they identify the best solution.

Stage 4: Prototype

In the prototype stage, the students validate the idea they selected in the ideate stage.

Stage 5: Test

Finally in the testing stage students determine which solution idea works and which does not. The best idea is selected and it goes into execution.

2. Computational Thinking

Computational thinking allows us to strategize how the problem can be solved. These solutions are then presented in a way that a computer, a human, or both, can understand. Thinking computationally is not programming. Simply put, programming tells a computer what to do and how to do it. Computational thinking enables us to work out exactly what to tell the computer to do.

Let's take a look at an example

Example of Computational thinking
While playing a video game, depending on the game, in order to complete a level you would need to know: • What items do you need to collect, how you can collect them, and how much time do you have to collect them? • What is the best route to complete the level in the quickest time possible? • What kinds of enemies are there and their weak points? From these details you can work out a strategy for completing the level in the most efficient way.

This example shows how computational thinking has been used to solve a complex problem.

3. Algorithmic Thinking

Algorithmic thinking automates the problem-solving process by creating a series of systematic logical steps that process a defined set of inputs and produce a defined set of outputs. Algorithmic thinking is thinking about how to solve a problem in a systematic way. It's about:

- Defining the problem clearly
- Breaking the problem down into small, simple parts
- Define the solution for each part of the problem
- Implementing the solution
- Making it efficient (eventually)

Algorithm

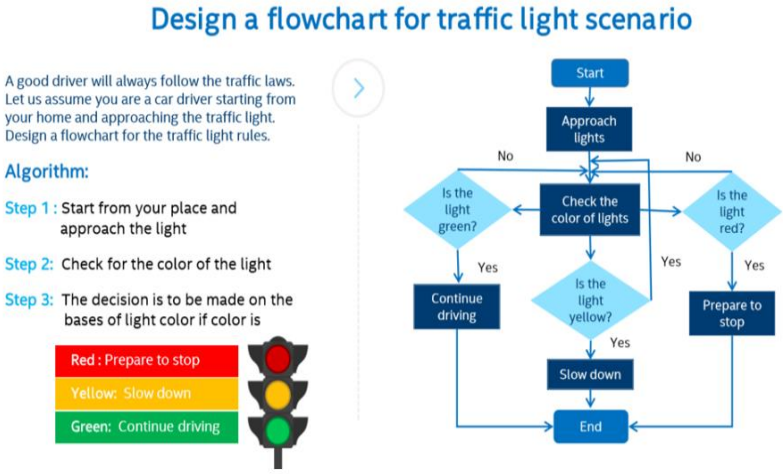
An algorithm is a plan, a set of step-by-step instructions to solve a problem. In an algorithm, each instruction is identified and the order in which they should be carried out is planned.

Flowcharts

A flowchart is a diagram that represents a set of instructions. Flowcharts normally use standard symbols to represent the different instructions.

Some of the symbols used in flowcharts

Name	Symbol	Description
Start/End		An oval represents Start and End in the flowchart
Arrow		An arrow line is a connector that shows relationship between the shapes
Input / Output		A parallelogram represents the input/output for the system
Process		A rectangle represents a process
Decision		A diamond indicates a decision



4. Physical Computing

Physical Computing is building/designing/creating/making interactive systems that use different kinds of software and hardware to sense and respond to an external stimulus – which could be a program, a problem statement, a need, an issue or simply an Idea.

Physical computing takes a hands-on approach, which means spending a lot of time building circuits, soldering, writing programs, building structures to hold sensors and controls, and figuring out how best to make all of these things talk to each other and give the desired output.

2.2. Introduction to Artificial Intelligence

Artificial Intelligence (AI) is being widely recognised to be the power that will fuel the future global digital economy. AI in the past few years has gained geo-strategic importance which makes it imperative for the current and future generations to be familiar with the presence and possibilities of this emerging technology.

What is Artificial Intelligence?

When a machine possesses the ability to mimic human traits, i.e., make decisions, predict the future, learn, and improve on its own, it is said to have artificial intelligence. In other words, you can say that a machine is artificially intelligent when it can accomplish tasks by itself - collect data, understand it, analyse it, learn from it, and improve it. Let us understand by taking an example.

Development of an Artificially Intelligent machine is similar to the way in which humans learn and evolve. For example, in elementary school, we learn about alphabets and eventually we move ahead to making words with them. As we grow, we become more and more fluent in the language as we keep learning new words and use them in our conversations. Similarly, machines become intelligent once they are trained on data (raw information) which helps them achieve their tasks. Like humans, an AI machine can also learn from its experiences to avoid making same mistakes and optimise its output.

Applications of Artificial Intelligence

There exists a lot of applications of Artificial Intelligence around us. Almost every industrial sector worldwide has been impacted by this technology and governments, companies and organisations are willingly adopting it to become ready for the future.

All of us interact with an AI application almost every day. Some of them are:

1. Search Engines: Whenever we have a question, instead of digging into books, we simply go online and ask our question to our favourite search engine. With the help of AI, these search engines not only understand our question, but also provide us the best results within fraction of seconds!
2. Smart Assistants: We nowadays have pocket assistants that can do a lot of tasks at just one command. Alexa, Google Assistant, Cortana, Siri are some very common examples of the voice assistants which are a major part of our digital devices.
3. Self-Driving cars: A self-driving car (also known as an autonomous car or driverless car) is a vehicle that uses a different number of sensors, radars, cameras, and artificial intelligence to travel to destinations without needing a human driver.
4. Recommendation Engines: AI has not only made our lives easier but has also been taking care of our habits, likes, and dislikes. Therefore, platforms like Netflix, Amazon, Spotify, YouTube etc. show us recommendations based on what we like.
5.

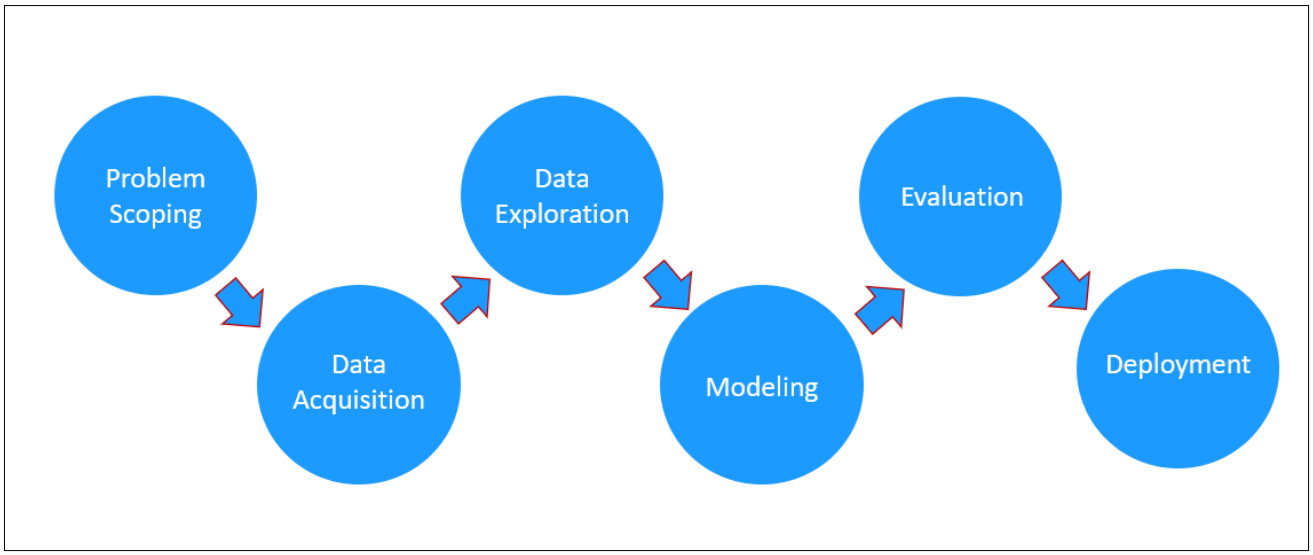
Domains of Artificial Intelligence

A machine becomes intelligent based on the training it gets; and the training is based on data. As you may know, data can exist in different forms – it can be attendance data, results data, comments on social media, music playlist, or even your photo gallery! Depending upon the application, an AI machine is trained on different types of data and based on the type of data being used, AI can be broadly classified in three domains:

1. Statistical Data
    a. Under this domain, data fed to the machine is in the form of numbers and/or alpha-numeric characters; usually put in the form of series or tables.
    b. Applications of AI in this domain are – Score Prediction, Weather Forecasting, Personalised advertisements etc.
2. Computer Vision
    a. Under this domain, data fed to the machine is in the form of images and/or videos.
    b. Applications of AI in this domain are – Face Unlock in Smartphones, Photo/Video filters, Auto-editing applications etc.
3. Natural Language Processing
    a. Under this domain, data fed to the machine is in the form of text or speech.
    b. Applications of AI in this domain are – Chatbots, Auto-translation, Spam filters etc.

AI Project Cycle

To develop an AI-powered solution, we need to break the entire process into stages. The AI Project Cycle framework helps us do the needful. It divides the process of developing an AI-based project into 6 stages as follows:

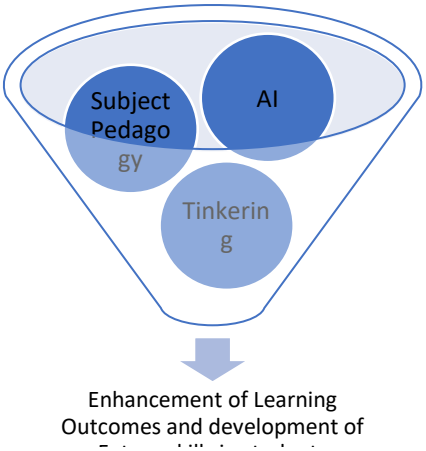


1. Problem Scoping: Under this stage, user defines the problem statement for which the solution is being developed. This stage also helps in defining the goal of the AI project.
2. Data Acquisition: To train the AI model effectively, true and ample amount of data needs to be acquired from authentic and reliable sources. Thus, Data Acquisition covers the Data Source selection and collection of Data.
3. Data Exploration: Under this stage, the acquired data goes through manual screening to ensure no corrupt or incorrect data gets fed to the AI model as it can hamper its output. Also, in some cases, the data collected is visualised to identify patterns and trends being followed by the dataset that may directly affect the output.
4. Modeling: Here, user selects an appropriate AI model to be trained with the data collected and cleaned in the previous stages. After training, the model becomes ready to be tested.
5. Evaluation: Post training, the efficiency of an AI model is tested under Evaluation stage. Based on the efficiency percentage, it is decided whether the model needs to be fine-tuned or re-trained or is good to go.
6. Deployment: Finally, once the AI model is ready, it is deployed in the real-time scenario where it is used to solve the actual problem for which it was developed in the first place; thereby completing the AI Project Cycle .

3. Chapter 3: Developing AI and Tinkering Integration Ecosystem

Implementation of AI and Tinkering has brought up a very interesting observation, when students are engaged in AI and Tinkering concepts and projects it leads to development of interest in core subjects of science, math, social science, languages, etc which further helps to enhance the learning level of the students. AI and Tinkering projects provides the functional / practical basis to the knowledge gained through multiple disciplines taught to the students. It is, therefore, an effective strategy that AI and Tinkering should be integrated with the formal school education system to enhance the learning levels of the students and develop the future skills in them.

The amalgamation of Subject pedagogy, AI and Tinkering leads to enhancement of the learning outcomes in the students and development of skills



It is further visualised that all the students at the school should be oriented to the spirit of innovation, invention and discovery by giving them opportunities to tinker and transact while using AI and envisions to bring all these initiatives under one umbrella and make 'AI and Tinkering for all', a possibility.

Principals as Innovation Leaders

The most critical 'agent of change' to bring about the paradigm shift proposed by the 'AIoT Integration in Curriculum' program will be the school leaders; they would have to play a significant role in this transformation and lead the programme as innovative leaders. They would be the pioneers to develop a conducive ecosystem in the school engaging all stakeholders.

Role of Principals' as innovative leaders can be seen in following manner.

- Lead the way towards effective integration and implementation of Artificial Intelligence and Tinkering enhance student learning.
- Encourage and motivate teachers to get trained and implement the program in regular classroom teaching and learning.
- Ensure effective and judicious use of Artificial Intelligence and Tinkering in the curriculum.
- Ensure optimum use of available resources to promote the use of Artificial Intelligence and Tinkering.
- Closely monitor effective implementation of the program.
- Finding creative ways of dealing with Artificial Intelligence and Tinkering funding.

4. Chapter 4: Integrating AI and Tinkering across Curriculum

4.1 Integrating AI and Tinkering in Formal Subject Pedagogies

While the approach to AI and Tinkering is different from the traditional formal approach, there are similarities between them and the curricular concepts. It has the element of scientific method which is used in various subjects. Just like a science or a math's problem, AI and Tinkering also begin by stating a hypothesis and then, through various inputs, suggestions, and permutations and combinations it moves toward forming a model or theory. While articulating the problem statement the students are able to see the alignment of their projects with the social problems covered in Social Science curriculum. Language - Listening, Speaking, Reading and Writing (LSRW) skills are developed along the AI and Tinkering project

life cycle and when the students use various medium to present and communicate about their projects. Thus AI and Tinkering integration can be a way to gain knowledge and skills that can lead to enhancing the learning levels of the students

Following are some activities and skills that can be considered relevant in academic teaching which can be supported by AI and Tinkering integration : -

- **Questioning Skills:** In AI and Tinkering project development, raising questions is the initiating point of each project. Considering from the pedagogical aspect, asking questions is one of the driving factors of formal education. Thus, these projects enable the students to develop skill of questioning and thus instilling the skills of curiosity and interest.
- **Reflection :** Reflection is an essential part of AI and Tinkering cycle as students actively observe and interpret throughout the project. This enables them to understand the application of the curricular concepts in better manner. They are able to understand the world around them and also express themselves better
- **Learning by doing:** AI and Tinkering provides impetus to the 'learning by doing' pedagogical approach that is an integral part of teaching and learning pedagogy .
- **Practical application of concepts:** AI and Tinkering enabled projects enable students to gain practical aspects of the concepts of math, engineering and scientific knowledge such as operational principles of tools, devices or components, knowledge of various materials, construction principles, etc.

Integrating AI and Tinkering with pedagogical practices has a very strong theoretical basis. The integration employs the concepts of **constructivism and constructionist theories of learning**. Social science theories of learning enable the students the understand the purpose and importance of the solutions they come up with by connecting it with Sustainable Development Goals.

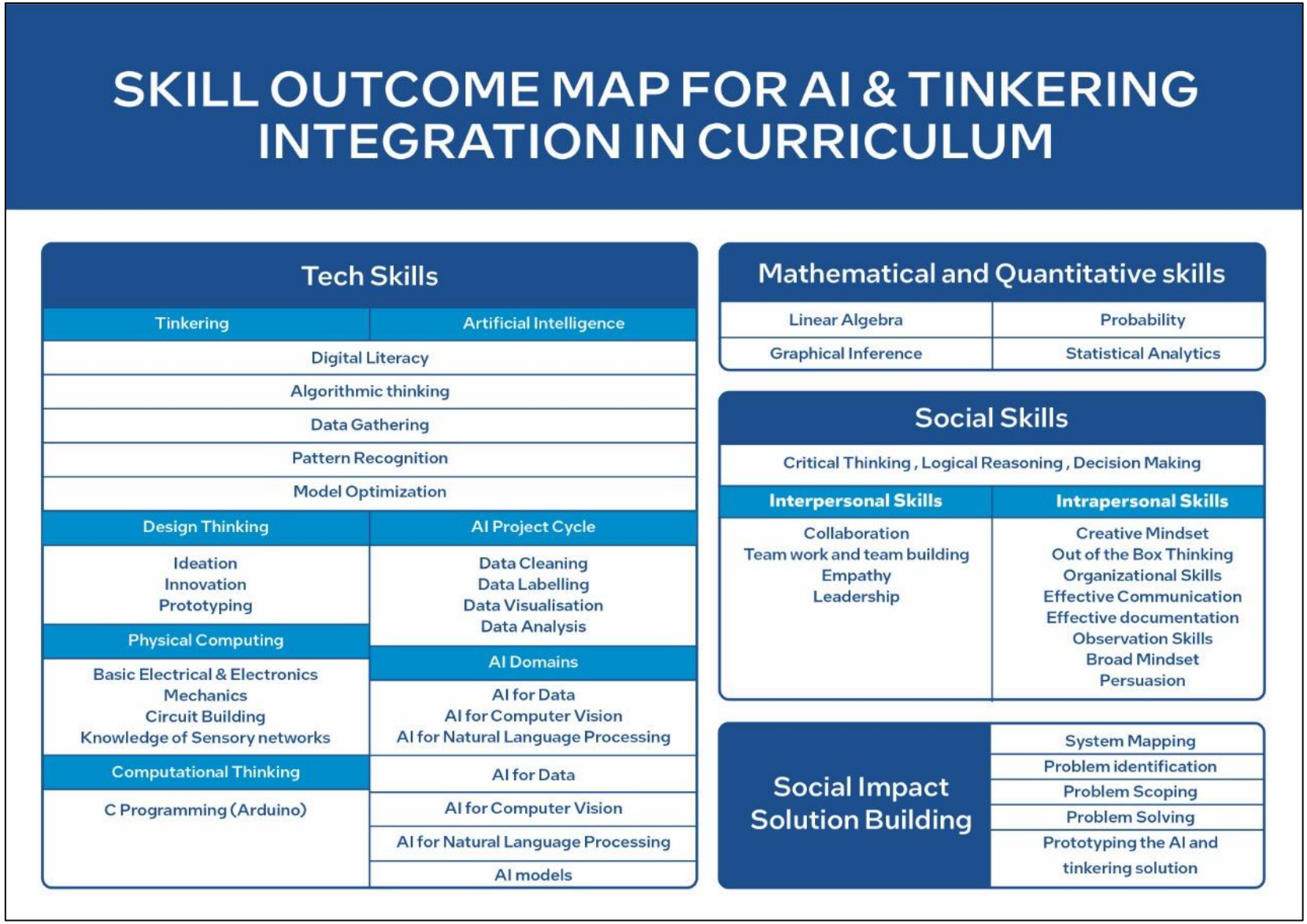
4.2 AI and Tinkering Integration alignment with Skill Development

Students can be empowered to be future ready by developing lifelong learning skills in them by connecting their knowledge with the world around them. AI and Tinkering integration with curriculum can prove to be effective way to keep pace with the need and requirement of skills required due to evolving technologies and their framework. It will enable us to nurture the students to sharpen their skills to get FUTURE READY.

Students will be provided with the following opportunities to enhance their Future Skills along with excelling in the curricular areas: -

- Prepare them to demonstrate responsible and professional behaviour and apply their academic and technical knowledge, and engage meaningfully in their communities.
- They will be able to demonstrate the ability to apply acquired knowledge to new settings. By doing this higher order thinking skills like problem solving, critical thinking, and research and synthesis will be developed in the students
- The integration of curriculum with AI and Tinkering will enable the education fraternity to apply the knowledge in cross-disciplinary contexts. This will enable the students to determine relationships among subject areas and relate academic learning to environments beyond the classroom.
- Students will be able to make use of technology skills and become successful in an ever-changing education and social landscape

AI and Tinkering Integration outcome Skill Map



5. Chapter 5: Implementation process and Guidelines

5.1. Suggestive Implementation Strategies

'AIoT Integration in Curriculum' program would be implemented in the following stages
It is expected that per term per class following numbers of AI and Tinkering integrated lesson plan to be implemented

- 1 Science
- 1 Social Science

For schools which do not have ATL labs the implementation shouldn't be a hurdle. They can utilize resources available in the Science lab and the other locally available resources to instil the 'Do it Yourself' Tinkering to understand the curricular concepts better and thus enhancing the learning level of the students.

Pre-Implementation - Suggestive Stages

Stage 1
2 teachers to be nominated by the school.
ATL in-charge / AI Teacher
Subject teacher - Science or Social Science /Academic coordinator

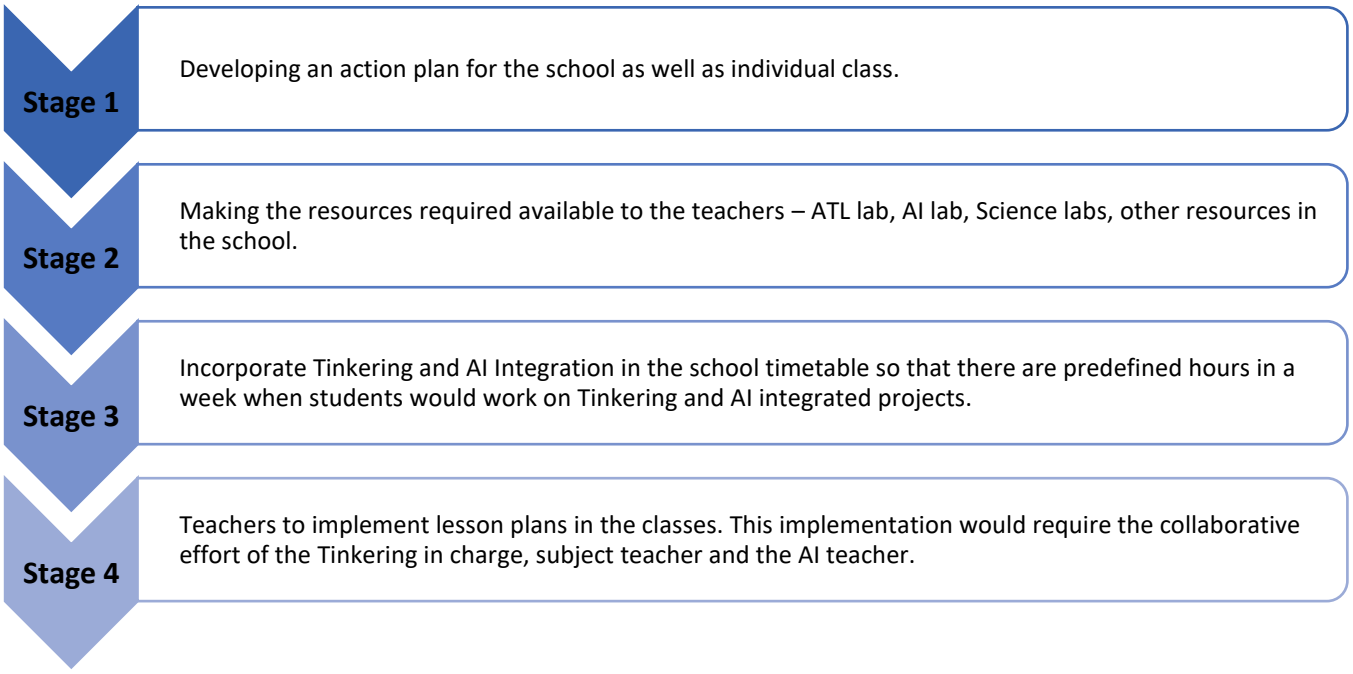
Stage 2
Teachers to undergo 'Integrating Tinkering and AI across Curriculum' master trainer training

Stage 3
Master trainers to develop their own lesson plans with the help of the lesson plans in the manual

Stage 4
Master trainers to train other teachers of the schools (in school training).
i. All the subject teachers
ii. AI teacher and ATL incharge

Stage 5
All the teachers to develop their own lesson plans with the help of the lesson plans in the manual.

During Implementation – Suggestive Stages



Post Implementation – Suggestive Stages

- Establish a Tinkering Club. All students of classes 6-10, based on self-interest and passion should be eligible to join.
- Students who want to explore and experience AI and Tinkering integration further would work on real-time projects and engage in active prototyping.
- These students get an opportunity to participate in external/internal competitions, challenges, innovation festivals etc.

5.2. Some more guidelines

- The AI and Tinkering integrated lesson plans are to be implemented with all the students of class 6-10 so that every student is introduced and provided exposure to the concept of innovation.
- All students would go through the basic stage of the lesson plan. The students who are more inclined and interested and desire to experiment and explore tinkering more they can go through the advanced stages of the lesson plan.
- The lesson plans are considering the integration of AI and Tinkering which culminates into a prototype of a project, this can add impetus to the project work that the students have to develop every academic year.
- To begin the program is being initiated in school having ATL lab and who have opted for AI as an elective subject. Later it will be taken to other schools who will be able to implement it by using the resources available in the school, science lab and can also purchase required resources for tinkering.

6. Chapter 6: AIoT Integration in Curriculum Lesson Plans

Class 6

Lesson 6.1

Garbage in Garbage out - Chapter 16

Parameters	Description	Note for teachers
Chapter Covered	Chapter 16: Garbage in Garbage out	This Lesson Plan contains pre-preparation activity, mapped with Chapter 16 Garbage in Garbage out
Name of the Book	NCERT, Science Textbook for Class VI	
Learning Objectives	This chapter addresses the issue of waste management problems faced in the 21st century. This lesson plan will help learners come up with solutions to improvise and/or innovate the already existing solid waste management systems. To enable learners to: **Scholastic:** **Stage 1: Conceptualization** ● Revisit and understand the concepts of biodegradable and non-biodegradable waste, plastic waste generation and disposal. ● Realize the magnitude of the problem of garbage disposal. ● Understand the concept of 3 r's – reduce, reuse and recycle. ● Connect with 12th un sustainable development goal - responsible consumption and production. **AI+ Tinkering** **Stage 2: Contextualization by applying Design Thinking Framework** ● Identify viable solutions for proper garbage management. ● Brainstorm ways to deal with garbage generation and segregation. ● Collect data and understand ways to analyse it. **Stage 3: Introduction to Teachable Machine for waste identification** ● Come up with an AI-enabled tinkering solution for waste identification and segregation. ● Understand how to train an AI model through an online user-friendly interface. ● Understand how Artificial Intelligence can be used for waste classification and identification. **Stage 4: Create their motor operated or manually operated Conveyor Belt** ● Devise a motorized or manually-operated conveyor belt system for waste segregation ● Appreciate how technology can be optimally used in waste identification and segregation.	

Time Required	5 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/projector with speaker ● Whiteboard and marker ● Computers with webcam (3 students :1 computer) ● Good internet connectivity ● Chart papers ● Bamboo skewers ● Glue ● Cardboard ● BO DC motors ● 9V Batteries ● PVC Pipes ● Thread	
Previous Knowledge	Design Thinking Framework	
Pre-preparation Activities	**Keep the following links ready before the session:** ● Fruit and Vegetable Decomposition https://www.youtube.com/watch?v=c0En-_BVbGc&ab_channel=webiocosm ***The teacher may conduct a composting activity to explain the concept of biodegradability*** ● SDG 12 - Responsible Consumption and Production https://www.youtube.com/watch?v=puEWxGStQrE ● Explore the image project section of the following tool for Stage 2 experiment: https://teachablemachine.withgoogle.com/ ● How to make a conveyor belt https://www.youtube.com/watch?v=UsF5lsjdgw4 **Teachers may go through the following videos for more information:** ● Recyclability, Compostability & Biodegradability Testing https://www.youtube.com/watch?v=pVioKtzn1u8&ab_channel=EcolStudio ● Video on Benefits of plastic https://www.youtube.com/watch?v=dR1zBU2aQL0&ab_channel=GPCAorg ● What really happens to the plastic you throw away - Emma Bryce https://www.youtube.com/watch?v=_6xlNyWPpB8&ab_channel=TED-Ed	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** ● Teacher explains the concept of rotting to learners through a video: https://www.youtube.com/watch?v=c0En-_BVbGc&ab_channel=webiocosm. ● Learners make observations and deliberate.	

- Teacher explains the concept of biodegradable substances, non-biodegradable substances and recycling based on the following points:
  - Name some non-biodegradable substances
  - What is the difference between the decomposition of paper and aluminium foil?
  - What is recycling?
  - Benefits of Recycling paper.
  - Plastics - Boon or Bane.
  - Alternatives to plastic.
- Teacher then acquaints students with the concept of Sustainable Development Goals and emphasizes on SDG-12 - Responsible Consumption and Production by showing this video: https://www.youtube.com/watch?v=puEWxGStQrE
- Teacher revisits the concepts of 3R's Principle (Reduce, Reuse and Recycle.)

A mind map or chart can be prepared to explain the various methods to manage waste based on 3R's principle

Contextualization:
AI and Tinkering:

Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher and ATL In charge)
Problem Statement / Scenario:
Varuna is a 26-year-old Masters graduate from Bengaluru, and a senior project leader in an architectural firm. Recently, she was touring Delhi with her college friends. When her car was passing the Ghazipur area, she mistook the landfills of Ghazipur with Aravalli hills. Such was the size of those landfills, that she was horrified. According to her driver, the landfill is used for dumping domestic as well as construction waste. It was supposed to be shut down almost 15 years back, but it is still in use. She noticed many rag pickers, especially children playing on the unhygienic garbage hills.
This experience made Varuna realize the magnitude of the problem of waste management. With her qualifications and experience, she wants to help her people and environment, by coming up with a plan that would help in safe garbage disposal and segregation.

The Teacher leads a healthy discussion while applying the design thinking framework to Varuna's 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:

- How did the waste pile up and took the form of a huge hill in 15 years?
- Why is the waste hill not reducing in size? (Hint: the extremely high presence of non-biodegradable components + low recycling rates etc.)
- What ill-effects does this dump yard might be having on people living in the vicinity? (Hint: polluted air, flies, odour)
- How much waste is generated in Delhi per day?
- How much waste is generated in your city?
- Is there any biodegradable component in kitchen and construction waste?
- Is waste segregation a possible solution to increase the recycling rates?

Define: Ask learners to identify the problem from the scenario above. Post brainstorming, the Teacher highlights the importance of waste segregation and how it can help in the proper disposal

of waste. The Teacher also sheds light on the fact that limited data exists about segregated domestic waste and how a collection of data can be the first step to tackle Varuna's problem.

Ideate:

Take-Home Activity - Engage learners in a take-home activity wherein they are required to perform a one-day study on domestic waste generation. Steps are:

- Collect the total waste produced in their house
- Segregate the waste based on the following categories:

Plastic Packaging	Metal Packaging
Tetra Pack cartons	Glass
Paper & Cardboard	Textile
Organic/Kitchen waste	Other

- Take images of individual waste elements from 2-3 different angles.
- Take 10-15 images of waste segregated in each category mentioned above (Each category of waste to have its own set of images)
- Create a table of your observations and submit the table and images to the Teacher.

Classroom Activity - Teacher to engage students in a group activity (5 students in each group)

- Weigh the mass of the segregated waste per category – weight machine to be arranged
- Each group prepares a table of individual and total waste generated values per category (grams or kilograms).

Category	Student 1	…	Student 5	Total
Plastic Packaging	100 gm	…	324 gm	XXX gm
…	…	…	…	…
Textile	12 gm	…	0 gm	YYY gm

- Further, the entire class collaborates to calculate the total amount of waste generated per category.
- The Teacher then guides them to calculate the approximate amount of waste generated by the whole school, block and city (Hint: They may use online information about the number of people living in their block/city).

Conclusion: The students focus on the fact that although biodegradable waste can be dealt with by composting it, non-biodegradable waste needs our attention.

Stage 3: Introduction to Teachable Machine for waste identification (Subject teacher and AI Faculty)

Empathize :

Ask learners to answer the following questions based on the previous scenario

- Ask learners if they can identify problems that might affect waste disposal at the dump yard.
- Does waste segregation play an important role in reducing the Ghazipur dump pile? If so, how?
- Do city workers at the waste disposal system identify waste before dumping or disposing of it? (Hint: Electromagnetic cranes are used to separate iron and/or wet and dry waste separation is done)

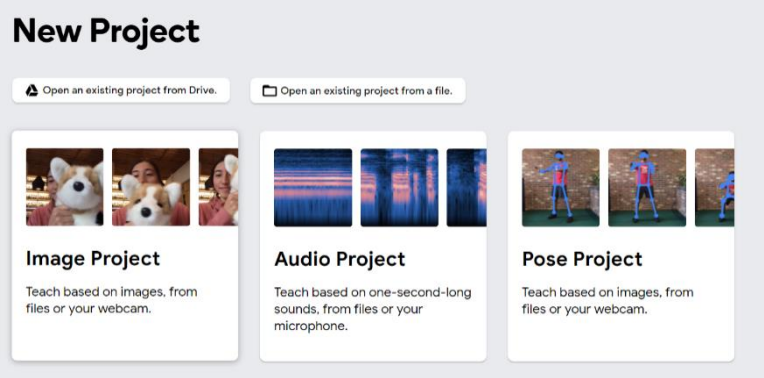
- Is this manual process of waste segregation efficient and hygienic? (Hint: The manual waste segregation takes a lot of time and manpower due to which a lot of times this crucial step is neglected and hence is directly sent for burial in dump yards or burnt while extremely toxic gasses are produced making the process harmful for humans).
- How was your experience while manually segregating the domestic waste?
- Can you imagine the problems faced by people actively working at city waste management Head Quarter/plant?
- Can we come up with a solution to help improve their working conditions?
- How do you think the management plans to get rid of this dump yard? (Hint: by burning plastic, rag pickers segregating manually, transferring waste using an excavator etc.)

Define: Ask learners to identify several problems that exist due to the non-segregation of waste and research on how technologies can help in the process.

Ideate: Ask learners to come up with solutions for creating systems of automatic waste segregation. Post brainstorming, learners are introduced to the Teachable Machine tool briefly. Also ask learners to come up with solutions for optimal waste transfer, identification and segregation. Lead them towards creating a conveyor belt that may carry loads of waste to a segregator and automate the entire process.

Using Teachable Machine for waste segregation

3.1 Link to access the tool - https://teachablemachine.withgoogle.com/train/image Learners visit the Teachable Machine platform and explore the image project section.



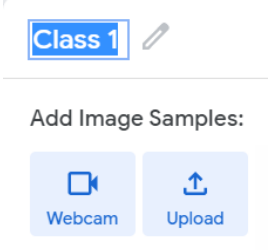
The Teachable Machine tool works in four steps:

3.2 Gather

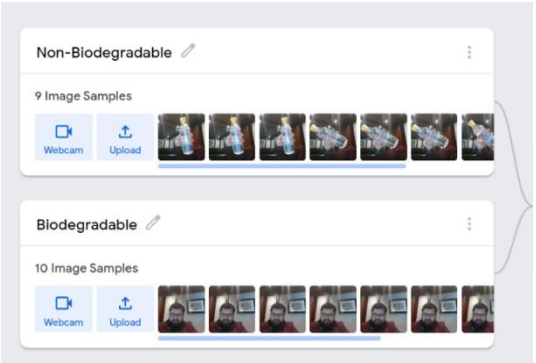
- Ask learners to collect waste materials they may find in their surroundings, OR
- Learners may use the images they had clicked during the take-home activity.

3.3 Feed -

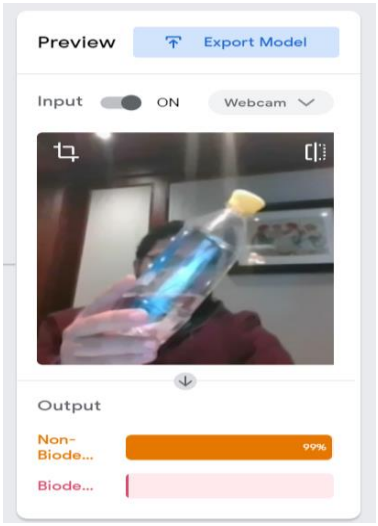
- Ask learners to rename Class 1 to Non-Biodegradable and Class 2 to Biodegradable.



3.4 Put the Non-Biodegradable objects one by one in-front of the camera while holding the 'Hold to Record' button. Do the same for Biodegradable objects in the section below

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


OR click on upload to put pre-clicked images in both classes

3.5 Train - Post upload, click on the 'Train Model' button and wait till the process is finished
3.6 Execute - The AI model is now ready to be tested. Bring objects of Biodegradable and non-biodegradable types in front of the camera and see if the AI model is able to identify them correctly or not.


Stage 4: Create their motor operated or manually operated Conveyor Belt (Subject teacher and ATL Incharge)

Learners work in groups of 3 and create their own motor operated or manually operated Conveyor Belt that can take the load of at least 5 waste items at a time while running. Watch the YouTube video on how to make a conveyor belt. https://www.youtube.com/watch?v=UsF5lsjdgw4

Based on the AI model execution, ask learners to share their observation on the following grounds -

Was the AI model accurate?
Did the AI model work for objects whose pictures were not fed into the computer?
How can we increase the efficiency of the AI model?
How do you think the model was working? [Higher Order Thinking Skills]
Ask learners to create a system where the conveyor belt carries the waste in front of the webcam and the AI model identifies it as Biodegradable or Non-Biodegradable

</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>
The learners will be able to

Classify recyclable and non-recyclable substances.
Categorizes various types of non-recyclable wastes (plastic, Tetra Pak etc).
Relate the rotting and biodegradability with the action of bacteria on substances.

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

	• Conduct simple investigations and measure physical quantities of waste generated in SI units. • Apply to learn garbage segregation in day-to-day life and make efforts to protect the environment. • Construct a conveyor belt model using material from the Atal Tinkering Lab. • Classify waste-article images, and label them in an AI classification model. • Train an AI model to identify waste-articles.
Glossary	• **Teachable Machine:** It is an online tool that enables a fast and easy way to create machine learning models for your sites, apps, and more without the need for coding. It can be used to detect poses, images and sounds. • **Conveyor Belt**: It is a mechanism that consists of two rollers and a continuous belt of some material like fabric, rubber or plastic. It is usually powered by one or more motors depending on the requirements. It is very commonly used in industries where parts need to be taken from one place to another. • **Mechanism:** A mechanism is a combination of parts that work together to perform a specific action.
Skill outcomes	**Tech skill** • Digital literacy • Algorithmic thinking • Data gathering • Model optimization **Design thinking** • Ideation • Innovation • Prototyping **Social skills** • Critical thinking • Decision making **AI domain** Computer Vision **Social impact solution building** • Problem identifying • Problem solving • Prototyping the AI and tinkering solution **Interpersonal skill** • Empathy Collaboration **Intrapersonal skill** • Organizational Skill •Creative Mindset

Class 6
Lesson 6.2
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.

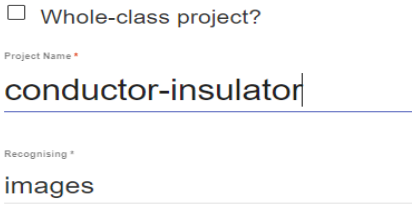
3.1 The ATL teacher shows them how to create a paper circuit with a switch made of copper tape.

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

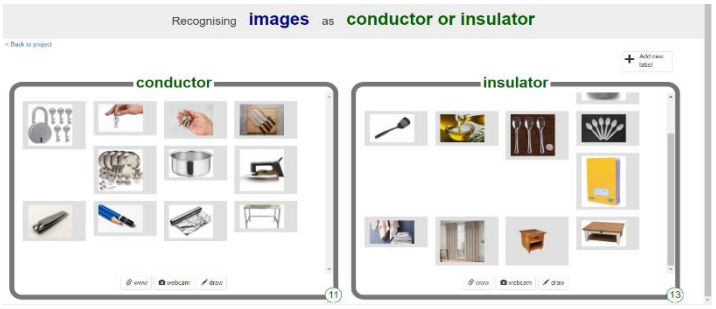
Stage 4: Introduction to an Image classification tool for classifying material as good or poor conductors of electricity (Subject Teacher and AI Faculty)

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.

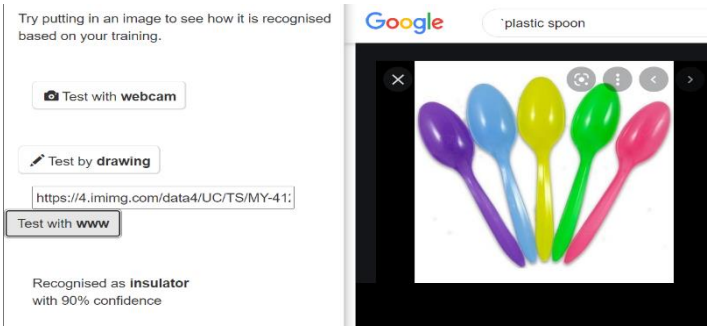


4.4 Add two labels named conductors and insulators and start adding images of household items to the respective labels



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:

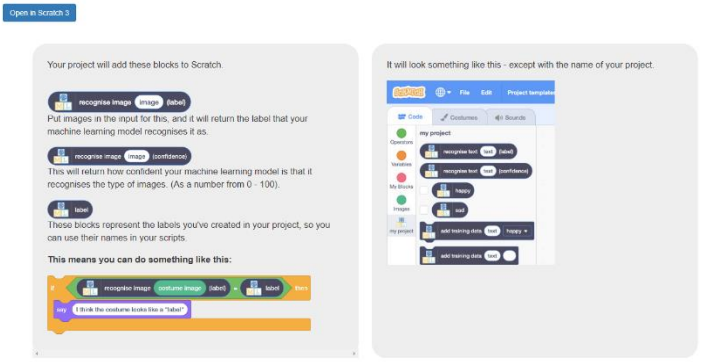
- Is the AI solution user-friendly?

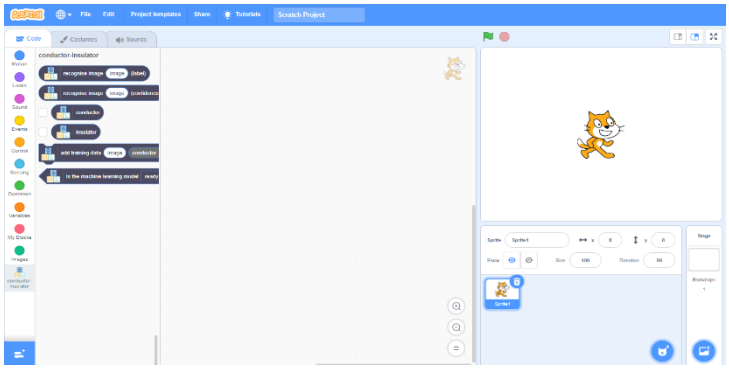
Define: Learners brainstorm on ways in which the AI model could be made more user-friendly with Scratch coding.

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

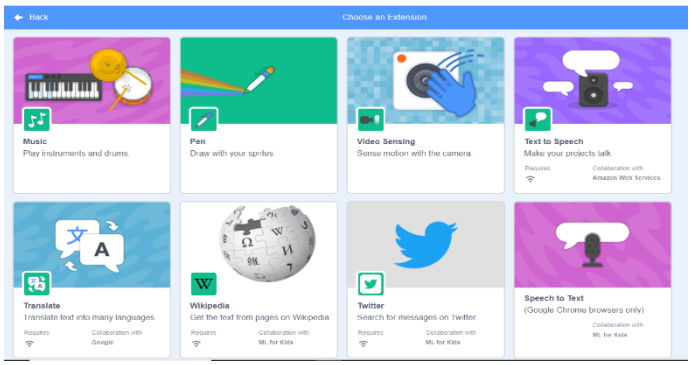
Use Scratch coding with AI Model Here are the steps to use Scratch coding with the AI model we created earlier

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.



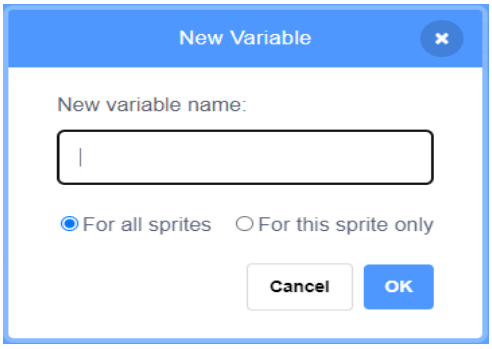


5.2 To sense the video feed, click on the blue square in the bottom left of the screen. When you click on it, you will see something like this:

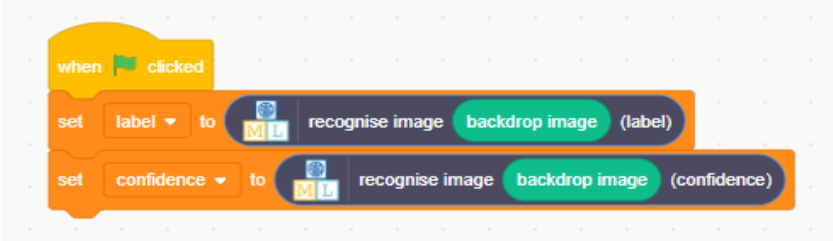


5.3 From these extensions, choose the **Video Sensing** extension. As soon as you include that extension, the background of the program starts showing your webcam's video.

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

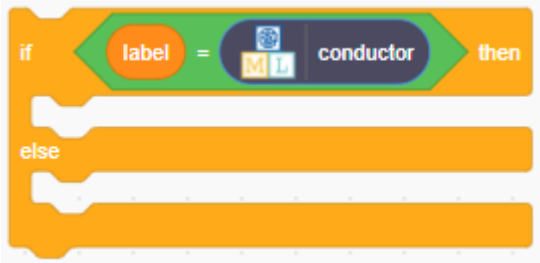


5.5 Then we will attach the following blocks from **Events**, **Variables**, **Machine Learning plugin** and the **Images** section:



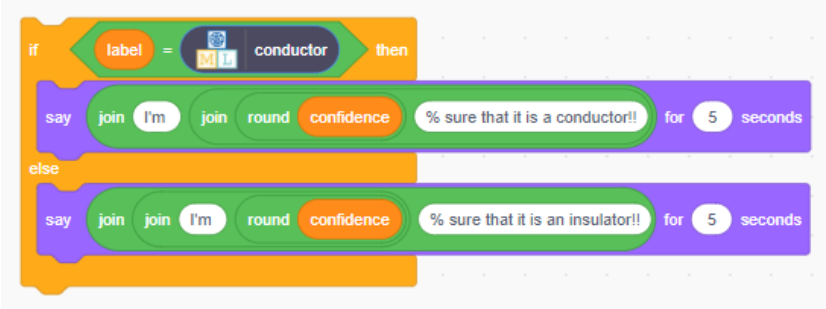
5.6 Create two variables named 'label' and 'confidence'. 'label' will store whether the observed image is identified as a conductor or insulator and 'confidence' will store the percentage of confidence that the AI model has for the prediction that it has generated.

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

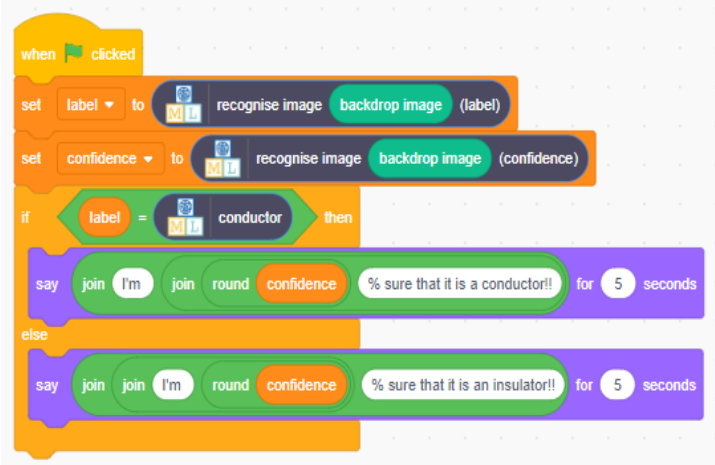


5.8 We will use the blocks from **Control, Variables, Operators,** and the **Machine Learning model** to create the above arrangement. This combination will be able to do different things based on whether the value of "label" is conductor or not.

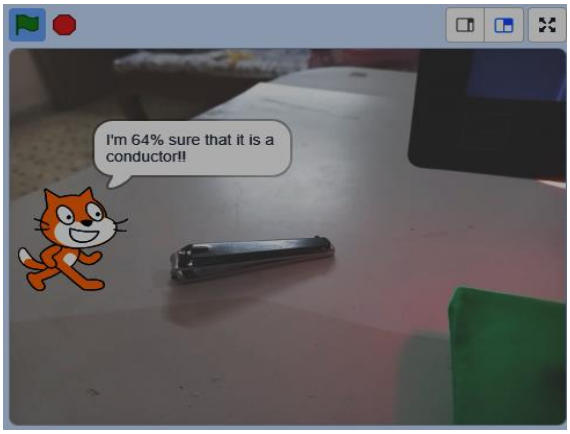
5.9 Now, attach some more blocks to create some output upon detection of the object:



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

Class 6

Lesson 6.3

Major Landforms of the Earth - Chapter 6

Parameters	Description	Note for teachers
Chapter Covered	Chapter 6: Major Landforms of the Earth	
Name of the Book	NCERT, Social Science Textbook for Class VI	
Learning Objectives	In the chapter Major Landforms of the Earth, we will be learning about major land form Like: - mountains their formation and classification. Plateaus and why are they also called table top, plains and the role of human being in preservation of mother earth. Also, we will be learning about the government's initiative of Swachh Bharat Mission. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Identify two types of forces acting upon the surface of the Earth – Internal and External. ● Recognize the changes on the surface of the Earth due to these forces. ● Explain the formation of mountains and differentiate between the types of mountains. ● Explain the formation of plateaus and locate and list their usefulness. ● Explain the formation of plains and why the plains are densely populated as compared to other land forms. ● Relate with water pollution and land degradation and suggest measures to prevent pollution and land degradation. **AI and Tinkering** **Stage 2 : Apply Design Thinking** ● Identify two types of forces acting upon the surface of the Earth – Internal and External. ● Recognize the changes on the surface of the Earth due to these forces. **Stage 3: Making landscape** ● Explain the formation of mountains and differentiate between the types of mountains. ● Explain the formation of plateaus and locate and list their usefulness. ● Explain the formation of plains and why the plains are densely populated as compared to other land forms. ● To create a landscape by creating various landforms and 3d printing it. ● To test the created landscape against water to test for soil erosion **Stage 4: Making AI enabled software** ● Relate with water pollution and land degradation and suggest measures to prevent pollution and land degradation. ● Use arduino hardware and coding in the ide. ● Apply ai to determine crop cycle.	Teachers can develop a ppt on minerals and energy resources, landforms and factors influencing the formation of land form.
Time Required	5 periods of 45 minutes each.	

Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular classroom arrangement. ● Activity Sessions – Flexible (for group / pair work).	
Material Required	**Scholastic**: ● Textbook ● Smart Board / Screen ● Projector ● Globe ● Map ● Chart ● Pen and paper ● Laptop or smartphone ● White board and marker **AI and Tinkering :** ● Arduino Uno ● Jumper Cables ● Soil Moisture Sensor ● DHT 11 Temperature Sensor ● USB Cable for Arduino Connect **Landforms of the Earth (Reference material):** ● https://www.twinkl.co.in/teaching-wiki/landforms	
Pre – Preparation Activities	**Scholastic**: ● A video to show the internal forces acting upon the surface of earth. https://www.youtube.com/watch?v=9qa0Mt7HpGY) ● Sand to make a sand castle for illustrating external force acting upon the surface of earth. **AI and Tinkering:** ● The teacher needs to install tinkercad into the available systems. The teacher needs to understand the basics of tinkercad. https://www.youtube.com/watch?v=gOs6Mdj7y_4 ● Design Thinking Flashcards to understand empathy, defining the problem and ideation ● Understand the working of Arduino and the basics of AI. https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s https://www.youtube.com/watch?v=2ePf9rue1Ao	flash card activity can be done on different land forms and endogenic and exogenic forces. The questioning method should be practiced to keep learners engaged and manage the class time.
Previous Knowledge	**Scholastic**: The teacher initiates a discussion on the places visited by the students or their hometowns to bring out their understanding. ● of the physical features of the places. ● of difference in terms of weather and population. ● water Erosion and the way it works. ● soil fertility and components of nutrients in soil. **AI and Tinkering:** ● The ability to empathise and think holistically towards a problem statement in hand.	

	• The ability to create basic designs in tinkercad. • Basic knowledge of data labelling and AI Modeling and how to interface a sensor and run a code on an Arduino.	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** **The teacher** • shows a video to make the learners recapitulate and understand the two types of forces of the earth. https://www.youtube.com/watch?v=9qa0Mt7HpGY • shows a demonstration of water waves and gusty wind affecting the sand castle. • asks the learners to list the changes in the earth due to the action of internal and external forces. • explains how different types of mountains are formed and makes use of maps to highlight the location of major mountain chains. **Activity**: • Experiment with a piece of paper to see how a fold mountain is formed. • Experiment to show the formation of Block Mountains through cutting of an eraser and showing the positioning in a way block mountains are formed. • The teacher asks the learners to research using Google Earth to find plateaus, in or around their country. Students identify the features of plateaus. • The teacher takes the students for a nature walk in the school garden, where they observe the flat and elevated surfaces. They identify the flat surface as plains and draw parallels to distinguish plains from the plateaus. • The teacher further holds a class discussion on the environmental issues leading to degradation of landforms of the earth. The suggestions to prevent pollution and land degradation are elicited from the students. (Reference for the teacher: 1. **Landforms (Closure Activity):** https://www.twinkl.co.in/teaching-wiki/landforms 2. **Formation of Block Mountains** https://www.youtube.com/watch?v=kw9mMKUgwBk) **Contextualization**: **AI and Tinkering**: **Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher & ATL in-charge)** **Problem Statement / Scenario:** *During a nature walk, Rani, a student, notices that some piece of land in the playground, adjoining the garden, is getting additional mounds of soil. She brings it up during discussion with the teacher in the class.* **Empathize**: The students brainstorm and analyse that the school gardener switches on the electric motor every day to pump out water for the plants in the garden and leaves the water pipe at one place for a very long time. The water overflows causing the soil also to flow and accumulate in the playground. The students are asked to ponder on the following questions: 1 What does Rani notice and what emotions might Rani be feeling? 2 What does he say or do? 3 What can be some advice/comments Rani gets from his friends/family? 4 Why are the students concerned? **Define**: Students are asked to think deeply and try to find a solution. They are asked to think about the following questions	

1 Do you also witness such situations?

2 Can you think together to help school authorities solve any one or all of the problems above?

Ideate: Students will now be asked to come up with different alternatives to resolve the issue of wastage of water and soil erosion.

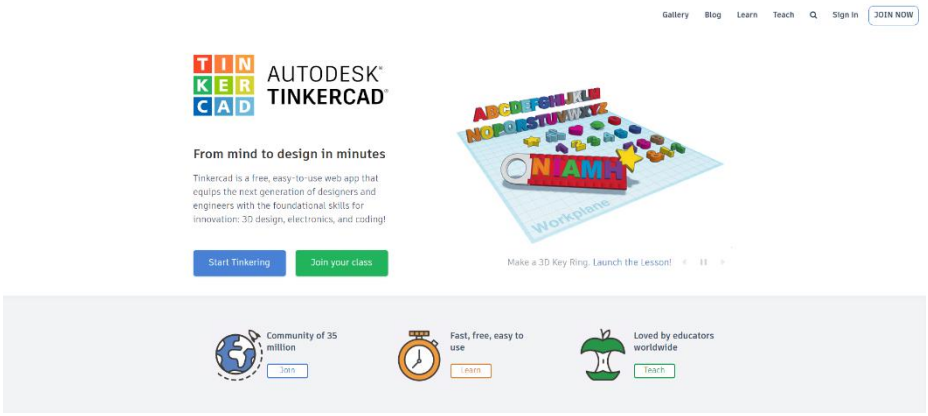
Stage 3: Making landscape using 3D printer and test the created landscape against water to test for soil erosion **- tinkering (Subject teacher and ATL in-charge)**

Aim:

- To create a landscape by creating various landforms and 3d printing it.
- To test the created landscape against water to test for soil erosion
- To use sensors and AI to detect and determine which part of the created landscape will have the most fertility in it for the required crops.

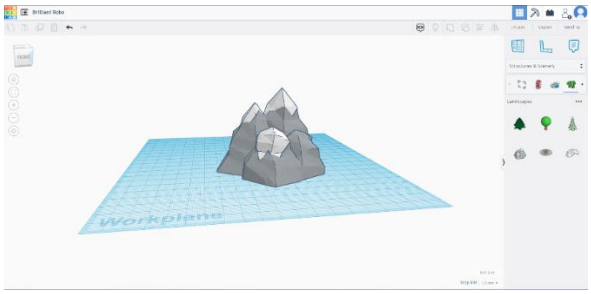
The steps to do so are:

3.1 Open TinkerCad: https://www.tinkercad.com/



3.2 Sign-in to the account via TinkerCad.com

Go to the main plane of 3d model creation from the tool. From the plane section on the right hand side, select the landscape and use the ready-made models of different landscapes to print. The basic tools can also be made available in the software to go ahead and create one's own customised landform as learnt and seen in the textbook.



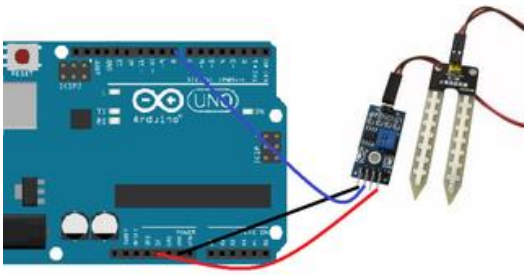
3.3 Create 3 similar landforms and generate a **.stl** file for the same.

3.4 3d print all these 3 platforms from ATL 3d printer with the help of ATL Lab Incharge.

3.5 Once 3 such different landforms are created, a small test landscape is built using a cardboard box.

3.6 The cardboard box is filled with sand in such a manner that the printed landforms can stay on the top of it. Now, place the 3d printed landforms in a box in such a manner that the least possible soil gets eroded.

Open Arduino Uno hardware and attach the soil sensor as mentioned in image below:



Step by step Guide: https://create.arduino.cc/projecthub/Dynamic_Innovator/make-your-own-soil-moisture-sensor-with-arduino-9b3b89

Stage 4: Making AI enabled software to predict fertility and moisture of the soil (Subject teacher and AI Faculty)

4.1 Place two such setups on different ends of the cardboard box.

4.2 Start measuring the soil moisture as and when water flows and measure it in every 15 mins for the next 3 days.
Based on the data and entries received, fertility and moisture of the soil can be predicted simultaneously as to which crops are relevant here to be grown.

4.3 Use the two tools mentioned to enter and train the dataset for the collected data. The dataset can also be trained, even if a particular data is not collected, by downloading the already given database on the links to help understand how the AI and prediction of crop rotation works.
https://machinelearningforkids.co.uk/#!/pretrained
https://cognimates.me/home/

4.4 Try and involve the AI part to predict the crop rotation and rowing cycle for the landscape created.

Learning Outcomes	The learner • identifies and understands the action of the two types of forces upon the surface of the Earth. • comprehends the reasons for the changes on the surface of the Earth due to internal forces and external forces. • understands the formation of mountains, plateaus and plains and differentiate between three of them. • relates with water pollution and land degradation in real-life situations and suggests measures to prevent pollution and land degradation. • gets familiar with 3D - Drawing and 3D Printing. • comprehends Arduino Hardware and Coding in the IDE. • applies AI to determine Crop Cycle.
Glossary	• **TinkerCad:** Tinkercad is a web app that equips with the foundational skills for 3D design. • **Arduino Uno:** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins. • **Soil moisture sensors:** It measures soil moisture at the root zone and regulates the existing conventional irrigation timer, resulting in considerable water savings when installed and used properly. • **Data Acquisition:** Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that is required for the AI model. There can be various ways to collect data.
Reference Links	• www.arduino.cc • https://towardsdatascience.com/tagged/arduino
Skill outcomes	**Tech skill** • Data gathering • Pattern recognition • Model optimization **Design thinking** • Ideation • Prototyping **AI Domain** • AI for Data **Mathematical and quantitative skills** • Probability • Statistical analytics **Physical computing** • Basic electrical and electronics. • Circuit building and Knowledge of sensory network **Social impact solution building** • System mapping • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution

Class 6
6.4
India: Climate, Vegetation and Wildlife - Chapter 8

Parameters	Description	Note for teachers
Chapter Covered	Chapter 8: India: Climate, Vegetation and Wildlife	-
Name of the Book	NCERT, Social Science Textbook for Class VI	-
Learning Objectives	Summer, winter, rainy, and autumn are the four seasons that exist in India. We will also study about the months that make up each season as well as the causes of the seasonal variations in the chapter India: Climate, Vegetation, and Wildlife. The following section will teach us about India's native flora and fauna, the significance of its forests, and the causes of deforestation there. To enable learners to **Scholastic** **Stage 1: Conceptualization** ● recall the difference between weather and climate. ● classify the seasons of India and infer the causes behind them. ● describe the influence of land, climate, vegetation, and wildlife on human life. ● appreciate the need for conserving natural vegetation and wildlife. ● analyse the impact of various factors of climate on flora of a region. **AI and Tinkering** **Stage 2: Apply Design Thinking framework** ● recall the difference between weather and climate. ● understand the good health of soil on the basis of moisture value. **Stage3: Developing hardware to record soil moisture** ● classify the seasons of India and infer the causes behind them. ● understand the good health of soil on the basis of moisture value and data Modeling. ● learn hardware integration. ● infer how the data collection is done and how to label data. ● gain knowledge of Arduino programming and integration. ● learn about how a soil health monitoring system can be developed using moisture data. **Stage 4: Enable the hardware developed to use the collected moisture data to predict whether the plant is healthy or not.** ● appreciate the need for conserving natural vegetation and wildlife. ● analyse the impact of various factors of climate on flora of a region. ● comprehend the Soil Moisture Sensor and its application. ● explore AI Modeling further using online tools to classify soil health.	Teacher can develop a Ppt focussing on Comparative of weather vs climate, Seasonal chart of India and factors effecting flora and fauna.
Time Required	5 periods of 45 minutes each	

Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular class room arrangement. ● Activity Sessions – Flexible (for group / pair work).	
Material Required	**Scholastic**: ● Textbook ● Smart Board / Screen and Projector ● Atlas / Map ● Pen and Paper ● Laptop or smart phone ● White Board ● Marker **AI and Tinkering :** ● Arduino Uno ● Soil Moisture Sensor ● Power Supply ● Jumper Cables **Climate Zones (Reference material):** ● https://www.geo41.com/climate-natural-vegetation#climate-zones	
Pre – Preparation Activities	**Scholastic**: For understanding the stages of plant growth and the prerequisite of a healthy plant such as moisture, soil nutrients and good climatic conditions. ● https://www.youtube.com/watch?v=TE6xptjgNR0 **AI and Tinkering:** Design Thinking Flashcards to understand empathy, defining the problem and ideation Understand the working of Arduino and the basics of AI. ● https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s ● https://www.youtube.com/watch?v=2ePf9rue1Ao	
Previous Knowledge	**Scholastic**: ● The teacher makes the learners recall India's weather patterns, types of forests and wildlife through a whole class discussion method. **AI and Tinkering** ● The ability to empathise and think holistically towards a problem statement in hand. ● Basic knowledge of data labelling and AI Modeling and how to interface a sensor and run a code on an Arduino.	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** **Introduction:** ● The teacher discusses the differences between weather and climate through the questioning method.	

- The teacher further explains the factors affecting the climate of a place: distance from the equator, distance from the sea and height above the sea level through examples.

Presentation:

- The teacher explains with the help of a diagram the arrival and return of the monsoon.
- Students are then shown a video for a visual representation of Climate, Natural Vegetation and Wildlife to help them understand better.
- The teacher brainstorms the reasons why forests are necessary.
- The students list the products obtained from forests and their uses.
- The teacher further discusses how the flora and fauna of the world together help to maintain the balance of the ecosystem.

Evaluation:

- Students are asked to note down the temperature from the newspaper and compare the same with the other states of India. (This will help them analyse the factors affecting the climate of a place to understand the changes that they notice on the natural vegetation.)

NOTE: - teacher can develop sample data collection sheet on weather pattern and share with student as activity.

- The students are given a table with temperature and rainfall of different places in India. They need to observe, analyze and find out about the type of vegetation they will find in these places.

Contextualization:

AI and Tinkering:Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher and ATL In charge)

Problem Statement/Scenario:

Rahul has planted saplings as part of his summer project. He waters the plants every day. But when winter begins, he notices the plants dying. He brings up this concern during a discussion with the teacher in the class.

Empathize:

Rahul and Justin have developed a habit of gardening as part of their summer vacation project. They had planted several plants at their homes. Rahul takes care to water the plants every morning and in the evening too. He feels happy to see the plants growing and flowering. As winter approaches, he notices that his plants are dying despite the same routine of watering the plants. He feels very concerned about this and discusses it with his friend Justin, whose plants are still in bloom. He is surprised to see Rahul's plants dying. The students might come up with following questions to think deeply about the scenario

1 What emotions might Rahul be feeling?
2 What does he say or do?
3 What are some advice / comments Rahul gets from his friends / family?
4 What does Rahul notice?

Define:

Can you relate with this problem?

1 What do you think is the problem in Rahul's Plant?
2 Would you like to initiate and give some suggestions by discussing it in your groups?
3 How you can help Rahul find a solution to his problem?

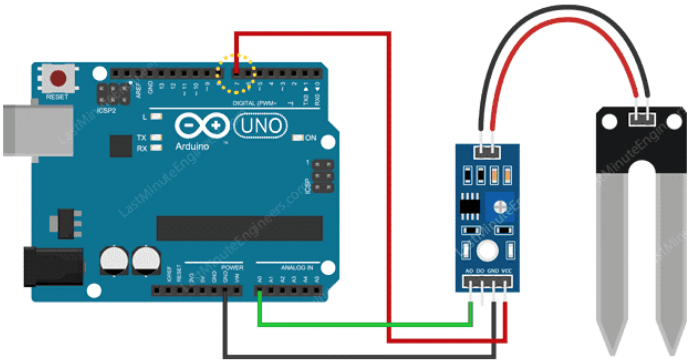
Ideate:

Learners will now be asked to come up with solutions to help Rahul in saving his plants from dying.

Stage3: Developing hardware to record soil moisture (Subject Teacher, ATL In-charge)

In this activity, the learners will learn about how a soil health monitoring system can be developed using moisture data.

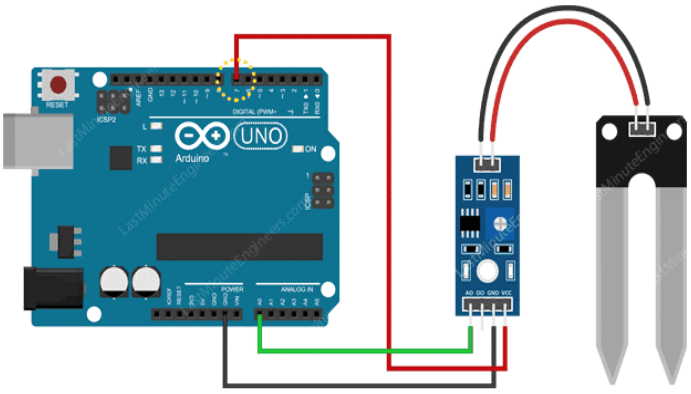
3.1 Hardware is connected according to the following Schematics:



3.2 Algorithm : After connecting the hardware according to schematics, the real time value of the moisture is derived from the soil as well as data from the algorithm, which is collected for further analysis. Following steps to be followed for the process:

3.3 Data Collection : Following steps to be followed to make the circuit working and start collecting the data.

Step 1: Make connections according to the schematics mentioned.

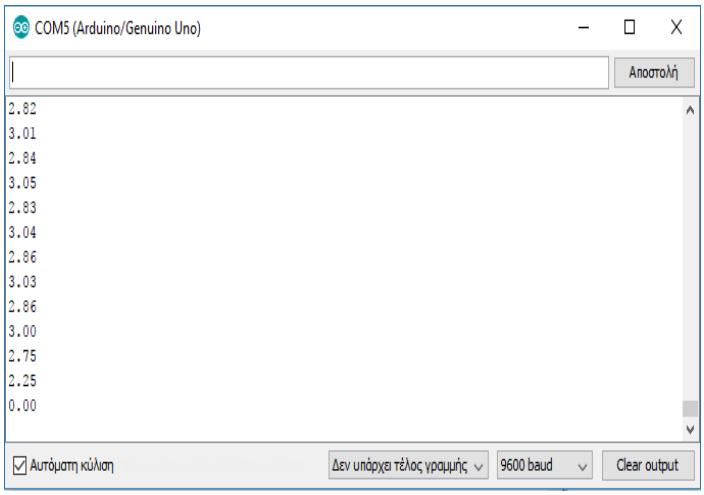


Step 2: Once connections are done, code using the logic given below and upload it to Arduino to visualise the data on serial monitor.

(Reference: https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s & https://www.youtube.com/watch?v=2ePf9rue1Ao)

```
int analogPin = A3; // potentiometer wiper (middle terminal) connected to analog pin 3
                    // outside leads to ground and +5V
int val = 0;  // variable to store the value read

void setup() {
```

```
 Serial.begin(9600);       // setup serial
}

void loop() {
 val = analogRead(analogPin); // read the input pin
 Serial.println(val);      // debug value
}
```



Step 3: Note the values in table format and proceed for further analysis.

Stage 4: Enable the hardware developed to use the collected moisture data to predict whether the plant is healthy or not. (Subject Teacher, ATL Incharge)

4.1 Data Processing and understanding the Use Case :

Journey in AI begins with this step, since data has already been collected in the previous step. Making use of the data, the Use Case of the data collected is understood.

1. Use Case - Use the collected moisture data to predict whether the plant is healthy or not.
2. Data Processing - After understanding the Use Case, the data is cleaned and processed to make an efficient AI model.

– This section will help explore the ways data collected from various sensors and stored in CSV files can be used in order to create an AI model.

4.2 Data Visualization is the process of presenting the data collected in the form of a chart, diagram, picture etc. It also includes the process of cleaning the data to make it ready to be used for training a model. In order to do so, the learner will go through http://machinelearningforkids.co.uk

The sensor readings should be stored in a sheet as given below.

Eg.

Sr No	Moisture Value
1	x
2	z

4.3 Data Labelling : The learner needs to make predictions based on Moisture data. In order to do that, an experiment needs to be conducted, where they note the Moisture value. Based on that, they label whether the plant is healthy or not.

Eg. Data from the green plant is taken and is labelled as healthy, Similar steps are followed for the dry plant and is labelled as unhealthy.

After adding the labels, the data might look as given below.

Eg.

S No	Moisture Value	Plant Health
1	X	Healthy
2	Z	Unhealthy

4.4 Data Transfer and Modeling :

Step 1: An account is created on the http://machinelearningforkids.co.uk website.

Step 2: Once registered, a new project is created by clicking on "Go to your Projects Page". Next, "Add a new project" button on the top right of the screen is clicked.

Step 3: In the details, the name of the project is specified as "Plant Health". Under Recognising, numbers are selected and finally a value as a Moisture Sensor is added using the Add Values button.

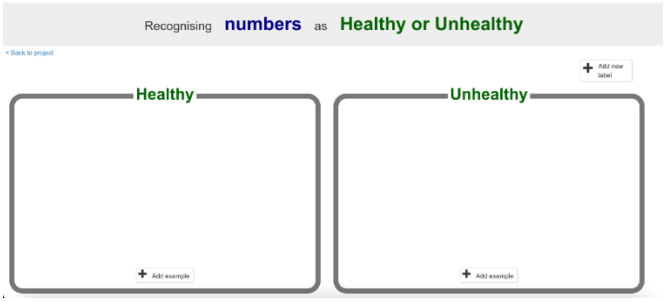
Step 4: Next, by clicking on Create option opens the Project page with three different options:

a. Train
b. Learn and Test
c. Make

Step 5:Starting by clicking on Train option and selecting the "Add a new label" option, different labels are added:

a. HEALTHY
b. UNHEALTHY

Step 6: After creating the labels, at least 10 examples are added for each label by putting the values appearing on the serial monitor for a particular type of soil:



Step 7: After the training data is added, the 'Learn and Test' option helps train the neural network with the obtained data. This is done by selecting the 'Learn and Test' -> 'Train new machine learning model' button.

Step 8:This will lead to testing of the neural network that has just been trained by giving it some values from the moisture sensor and noticing if the results obtained are as expected.

Learning Outcomes	The learner ● develops appreciation of the geographical diversity of the country leading to the cultural blend of different regions. ● understands and analyses the factors affecting the climate of a place through a mind map. ● states similarities and differences between weather and climate. ● is sensitised towards the impact of human activities on nature. ● relates processes and phenomena with causes and effects, applies scientific concepts in daily life to solve problems. ● analyses the good health of soil using AI Modeling. ● applies learning to hypothetical situations.
Glossary	● Soil Moisture Sensor A soil moisture sensor measures the volumetric water content of soil. All living things need water to survive. But for plants and agriculture, having just the right amount of water (not under / over-watering) is crucial. Since it is impossible to visually observe moisture levels in the soil with our naked eyes, soil moisture sensors play an important role in providing insights into the irrigation systems. The Soil Moisture Sensor is in the context of changes in electrical conductivity of the earth (soil resistance increases with drought).  The electrical resistance is measured between the two electrodes of the sensor. A comparator activates a digital output when an adjustable threshold is exceeded. ● Comparator: A comparator is a device that compares two voltages or currents and outputs a digital signal indicating which is larger. ● Algorithm: An algorithm is a set of instructions for solving a problem or accomplishing a task. ● Use Case: application of data collected for predicting the possible outcome. ● Data Acquisition: Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that is required for the AI model. There can be various ways to collect data. ● Data Exploration: Data Exploration refers to visualizing the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualize the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. ● Data Modeling: Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split into a training set and a testing set. The model is trained on the training set from which it makes its own rules that help the machine to give an output and the model is then evaluated on the testing set.

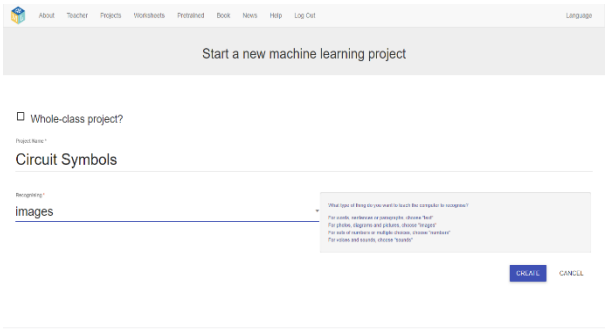
Reference Links	● https://create.arduino.cc/projecthub/biharilifehacker/soil-moisture-sensor-with-arduino-uno-2f118b ● https://lastminuteengineers.com/soil-moisture-sensor-arduino-tutorial/ ● https://www.youtube.com/watch?v=EjbHXMzeX4c
Skill out comes	**Tech skill** ● Digital learning ● Algorithmic thinking ● Data gathering ● Pattern recognition ● Model optimization **Design thinking** ● Ideation ● Innovation ● Prototyping **AI domain** ● AI for Data **Mathematical and quantitative skills** ● Probability ● Statistical analytics **Interpersonal skill** ● Empathy **Intrapersonal skill** ● Observation skill Persuasion **Social impact solution building** ● Problem identifying ● Problem scoping ● Problem solving ● Prototyping the AI and tinkering solution

Class 7
Lesson 7.1
Electric Current and its Effects - Chapter 14

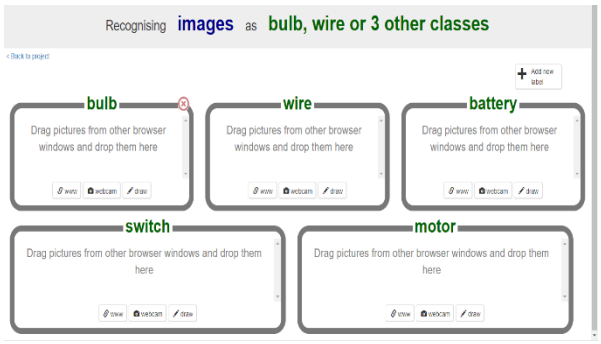
Parameters	Description	Note for teachers
Chapter Covered	Chapter 14: Electric Current and its Effects	This Lesson Plan must be taken after teaching the 'Section: 14.4 – Electromagnet from Chapter 14: Electric Current and its Effects
Name of the Book	NCERT, Science Textbook for Class VII	
Learning Objectives	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=DwHlhDrqcuw 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	

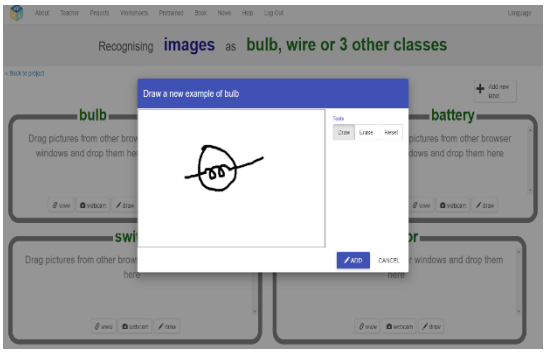
	○ How to make an electromagnetic swing https://www.youtube.com/watch?v=9ZwOvOVlljg ● Teacher explores the following online tools before the session: ○ Machine Learning for Kids www.machinelearningforkids.co.uk ○ PHET Simulations on electromagnetism https://phet.colorado.edu/en/simulations/magnets-and-electromagnets ● 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: 1.1Thermal 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 to make an electromagnetic swing. They are also presented with a task to classify electrical symbols and understand the magnetic effects of electricity. **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.



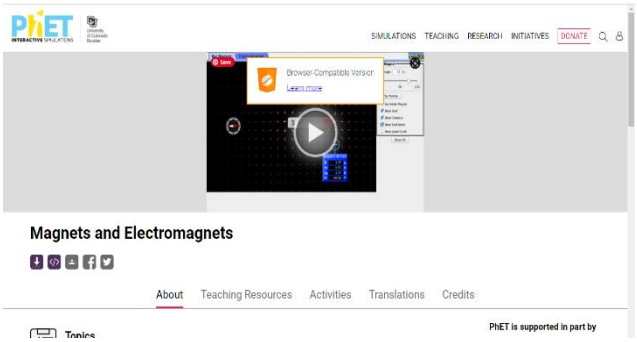
2.3 Now, learners put drawings or images of the electrical symbol for each component they added as label. Add at least 10 samples per label.



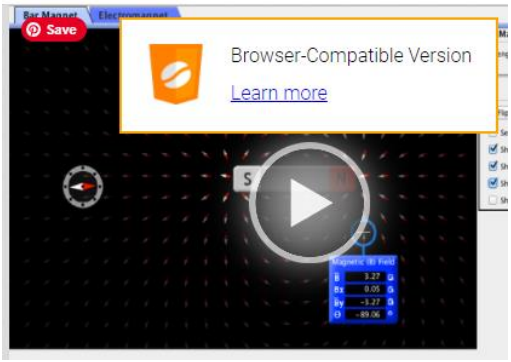
2.4 After adding 10 different images for each label, train the model by going to "Learn and Test" and clicking on the "train new machine learning model".

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.

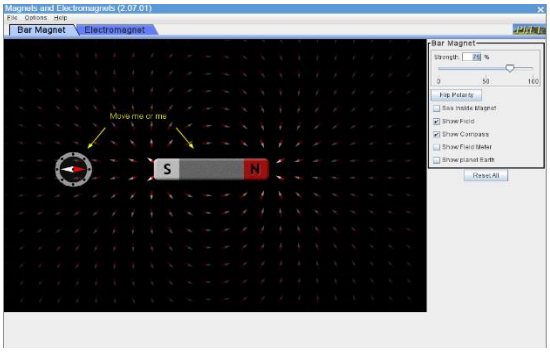
2.6 At this stage, learners explore an online simulation software to understand the dynamics of electromagnetism. Here's how: Visit https://phet.colorado.edu/en/simulations/magnets-and-electromagnets



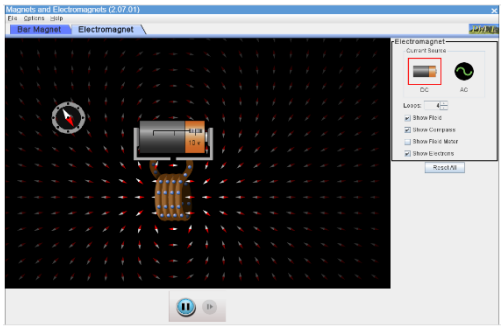
2.7 To run the simulation in the browser, click on the Play button



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



2.9 Go to the electromagnet tab



2.10 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.

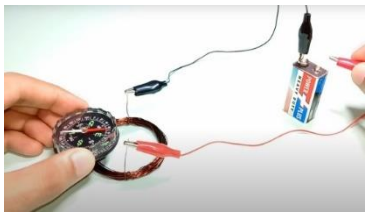
Stage 3: Building a perpetual swing toy using DIY construction kits and applying electromagnetic concept (Subject teacher and ATL in charge)

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=9ZwOvOVlIjg

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

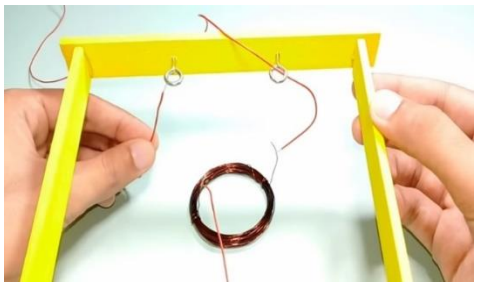
3.3 Now, connect the coil to the battery while keeping a compass very close to the coil. As soon as you connect the coil to the battery, you should notice a deflection in the compass



3.4 Now, create a frame of the swing

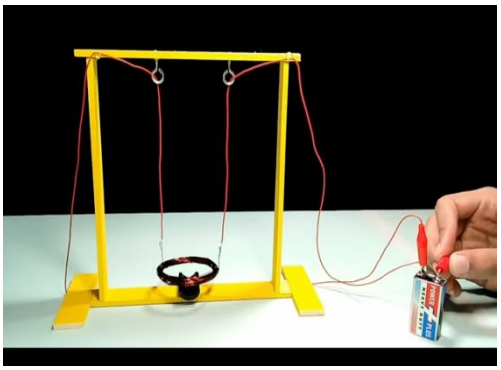
3.5 Now, connect two wires of 40 cm length on each end of the copper coil

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

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


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.
</td></tr>
<tr><td>Learning Outcomes</td><td>
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.

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

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.

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

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

Class 7

Lesson 7.2
Light- Chapter 15

Parameters	Description	Note for teachers
Chapter Covered	Chapter 15: Light	This Lesson Plan must be taken after teaching the 'Section:15.2 – reflection of light, or at the end of the Chapter
Name of the Book	NCERT, Science Textbook for Class VII	
Learning Objectives	This chapter covers the laws of reflection and refraction. As well as image formation by mirrors and lenses. Convex or concave lens exhibit a fixed focal point, which determines the distance of real or virtual images formations. This lesson plan will make learners identify the unknown focal length of any lens type, and also experience real/virtual image formations. To enable learners to **Scholastic:** **Stage 1: Conceptualization** ● Unravel the two laws of reflection. ● Understand the concept of reflection by mirrors/shiny surfaces. ● Comprehend the working of plane mirrors and spherical mirrors to propagate light. ● Differentiate between real and virtual image. **AI+Tinkering:** **Stage 2: Contextualization by applying Design Thinking framework and develop an LDR-based light intensity meter (Subject Teacher & ATL In-charge)** ● Understand how to use microcontrollers to collect data. ● Witness the working of an LDR sensor. **Stage 3: Making interactive quiz on Light using Inklewriter** ● Learn the use of inklewriter for making interactive quizzes. ● Understand how AI-enabled chatbots work	
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	● White board ● Marker ● Arduino UNO ● LDR ● 10kOhm resistor ● Jumper wires ● Breadboard ● Laptop/computer, ● 2 scales or an optical bench ● Light source (phone/flashlight, candle, led) ● Double sided tape.	
Pre – Preparation Activities	Facilitator to keep the following links ready before the session: ● Reflection of Light and reflection by mirrors https://www.youtube.com/watch?v=skGmQC87Bvg ● Laws of Reflection https://www.youtube.com/watch?v=OrobTDEYs2M ● Concept of real and virtual image https://www.youtube.com/watch?v=EwBK_cXUTZI ● Convex lens : https://www.youtube.com/watch?v=3G_6Kfk-Dmk ● Concave lens: https://www.youtube.com/watch?v=sXx_jj8H7-k ● Facilitator to explore the inklewriter platform before the session at https://www.inklewriter.com/	
Previous Knowledge	Basic knowledge of sources of light.	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** Quote Charles Lindbergh by saying: *"I think the light of science is so dazzling that it can be evaluated only by studying its reflection from the . . . mirror of life."* ● The facilitator will now ask learners to share their understanding about light, reflection, and why is required for us to see? ● The following video on reflection of light will be shown https://www.youtube.com/watch?v=skGmQC87Bvg ● The information from the video will be reinforced in a discussion, covering these topics ○ Luminous objects and non-luminous objects ○ Examples of luminous and non-luminous object around us ○ What makes us see non-luminous objects? (Hint: Reflection of light) ○ What is an Image? ○ Is an Image the same as a Shadow? ● Now, following videos will be shown to the learners ○ Laws of Reflection https://www.youtube.com/watch?v=OrobTDEYs2M ○ Regular and Irregular surfaces	

https://www.youtube.com/watch?v=6oy0Z3s4FXo&ab_channel=KnowledgePlatform

- Real and virtual image https://www.youtube.com/watch?v=EwBK_cXUTZI
- Convex Lens: https://www.youtube.com/watch?v=3G_6Kfk-Dmk
- Concave Lens: https://www.youtube.com/watch?v=sXx_jj8H7-k

The teacher can make learners prepare ray diagrams with the help of demonstrations, making them physically observe and comprehend the meaning of real and virtual images.

Contextualization:
AI and Tinkering:

Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario and develop an LDR-based light intensity meter (Subject Teacher & ATL In-charge)
Scenario:

Suhas is a grade 7 learner, and is currently building a telescope for a school science exhibition. He followed a DIY online tutorial, and ordered a range of different concave and convex lenses as required for that project. But upon arrival, he noticed that the lenses were not marked with the type of lenses and their focal lengths. So he has to figure out a way to quickly and reliably measure the focal length of various different lenses. How can you help him?
The facilitator will lead a healthy discussion while applying the design thinking framework on Suhas's scenario.

Empathize: Ask learners to reflect on the given scenario based on the following points and understand Suhas' problem and empathize with him:

- What is a telescope?
- Suhas is taking help from online tutorials. What does this information tell us about Suhas?
- What do you think the problem is which Suhas is facing?
- If he is unable to solve the problem what will be the repercussions?
- If he is not able to identify the type of lenses and their focal lengths, do you think the lenses would be usable in the manner they are supposed to be in the project?

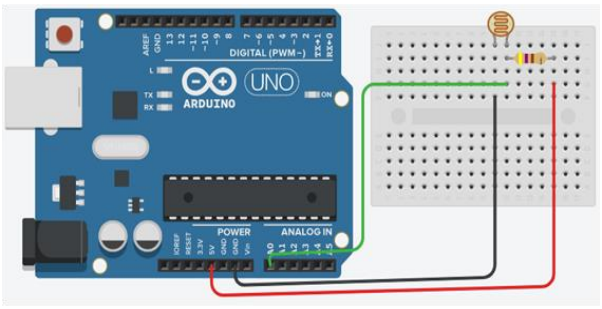
Define: Ask Learners to identify the problem from the scenario above. Post brainstorming, the teacher highlights the importance of knowing the type of lens for using it in the most efficient manner.

Ideate: Learners will be asked to brainstorm various ways they can use the concept of light, laws of reflection, images formed by plane mirrors, image formed by concave lens and convex lens to find out the type of lens and their focal length.

Prototype:

In this Stage, learners determine whether the image produced by the surface is real or virtual based on LDR sensor readings. Here are the steps to perform this experiment:

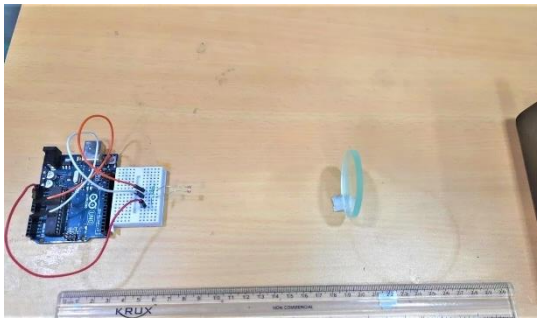
2.1 Here is the schematic diagram of the circuit. Develop the circuit based on the schematic

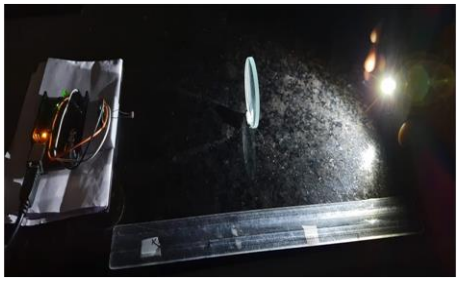


2.2 Upload the code below in the Arduino UNO

```
const int ldrPin = A0;
 void setup()
 {
 Serial.begin(9600);
 pinMode(ldrPin, INPUT);
 }
void loop()
 {
 int ldrStatus = analogRead(ldrPin);
 Serial.println(ldrStatus);
 delay(800);
 }
```

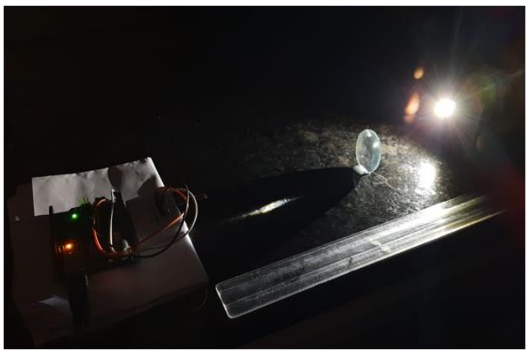
2.3 To get optimum result in LDR sensor, use scale and light source with closed lid environment (Similar to optical bench in dark room). Set your apparatus as showing in picture



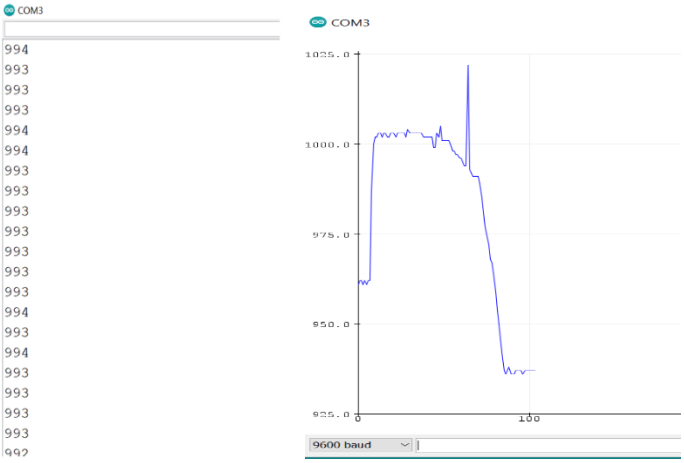


2.4 Now use a measuring scale to place the LDR circuit at different lengths from the lens and fix the position of the light source.

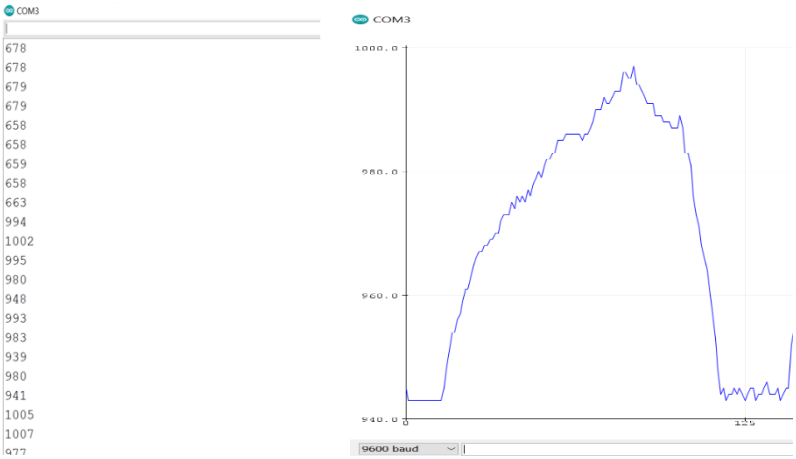
2.5 Now open the serial terminal/serial plotter to take readings at various lengths for ex: 5cm, 10cm, 15cm etc.



2.6 Check the LDR sensor values in Serial monitor/ Plotter for Concave lens



2.7 Now repeat the steps above and replace the concave lens with a convex lens and observe the values in Serial monitor/ Plotter.

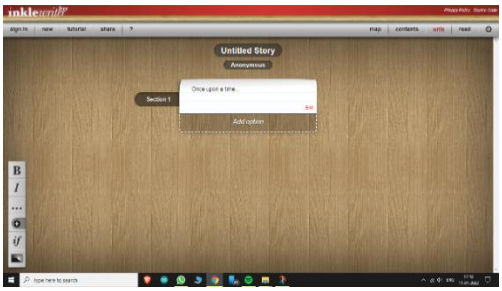


Thus, we can conclude that the light intensity keeps on falling as we go further away from the concave lens, which indicates that there is no converging point and hence no real image. Whereas with the convex lens, we can see that the light intensity goes from low to high and then high to low, indicating that it converges at one point, hence the image made by a convex lens is real.

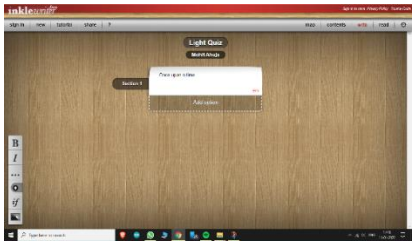
Stage 3: **Making interactive quiz on Light using Inklewriter** (in doing so the students will also understand how AI enabled chatbots work**(Subject Teacher & AI Faculty)**

Learners will create a small quiz using inklewriter on the topic of light based on their learnings from the chapter. Here are the steps to follow:

3.1 Go to: https://www.inklewriter.com/

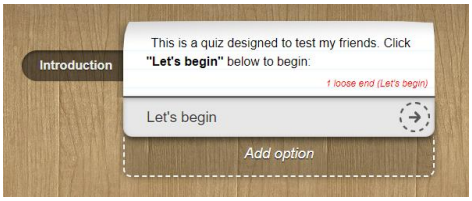


3.2 Change the title of the story from "Untitled Story" to "Light Quiz". Also replace the Anonymous with your actual name:

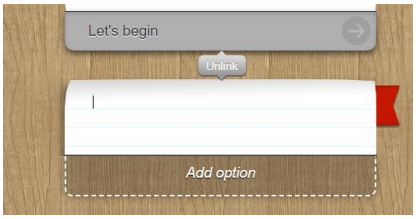


3.3 Rename the "Section 1" to "Introduction". In this section, you should describe what this quiz is about give an exciting introduction to it

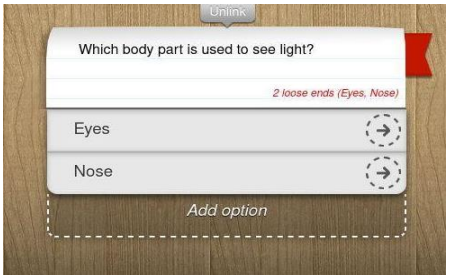
3.4 Options can be added by clicking on the dotted box and typing the name of the option. Add a single option "Let's begin"

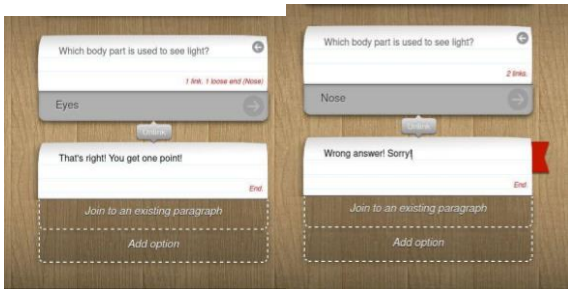


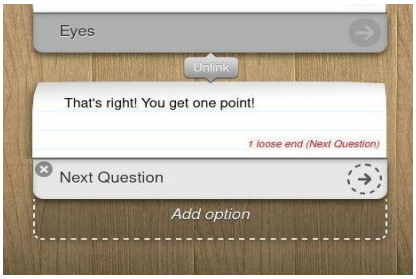
3.5 After that, click on the dotted circle with an arrow inside to define what should happen when we click on "Let's begin"



3.6 In this new section, add the first question related to the chapter and then in the options, add one right answer option and one wrong answer option. Here's an example

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


3.7 Add appropriate messages for right and wrong answers


3.8 Now go back to the right answer option and add a “Next question” option so that one could advance to the next step


3.9 In the “Next Question” section, you can now add a new question and repeat the steps above.
3.10 After writing all the questions above, you can switch to read mode and then share the quiz with your friends</td></tr>
<tr><td>Learning Outcomes</td><td>The learners will be able to
Scholastic:
● apply the laws of reflection in real life.
● apply the concepts of concave lens /convex lens and real image/virtual image. for solving the problem of identifying the type of lens and their focal length.
Tinkering and AI:
● learn how to use inklewriter to write interactive stories.(understand how chatbots work).
● learn how to use Arduino to read Analog data.</td></tr>
<tr><td>Glossary</td><td>● Inklewriter: Inklewriter is a free tool designed to allow anyone to write and publish interactive stories. It’s perfect for writers who want to try out interactivity, but also for teachers and students looking to mix computer skills and creative writing.
https://www.inklestudios.com/inklewriter/
● Arduino microcontroller: Arduino is an open-source development board. It consists of an integrated circuit, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload programs to the physical board.
Download the Arduino Software from: https://www.arduino.cc/en/Main/Software</td></tr>
</table>

	• **Light Dependent Resistor:** LDR is a Light Dependent Resistor. LDRs are made from semiconductor materials to enable them to have their light-sensitive properties. Their resistance decreases as the light intensity increases, used as street light control circuits.
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern recognition • Model optimization **Design thinking** • Ideation • Prototyping **AI domain** • AI for Data **Mathematical and quantitative skills** • Graphical inference **Interpersonal skill** • Collaboration **Intrapersonal skill** • Observation skill **Social impact solution building** • Problem identifying • Problem solving **Physical computing** • Basic electrical and electronics. • Circuit building

Class 7

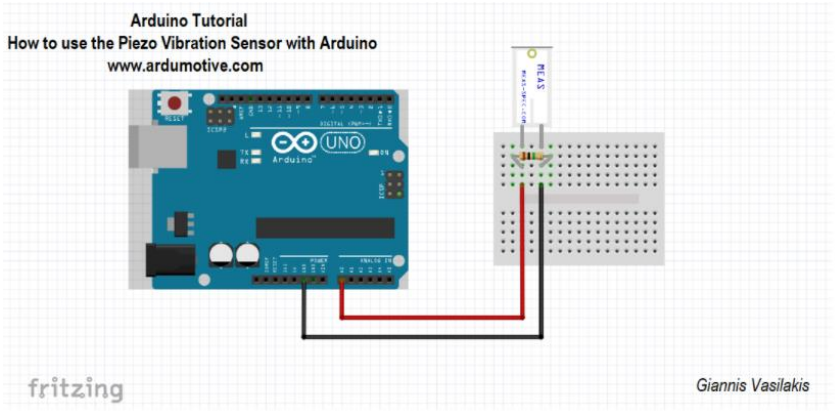
Lesson 7.3

Rulers and Buildings : Chapter 5

Parameters	Description	Note for teachers
Chapter Covered	Chapter 5: Rulers and Buildings	
Name of the Book	NCERT, Social Science Textbook for Class VII (History-Our Pasts-II)	
Learning Objectives	The rulers and construction chapter will teach us about India's medieval and modern architectural styles. It fosters in students an appreciation of engineering methods and the significance of archives in the preservation of history and legacy. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Identify types and purpose of structures built by kings/rulers. ● Appreciate the engineering skills and construction of monuments in medieval times and understand different types of architecture. ● Understand the significance of the building (to establish piety of the ruler). ● Realize the periodic influence on the style of architecture. **AI and Tinkering:** **Stage 2: Apply Design Thinking framework** ● Interpret how the structural health of a building works and the analysis is done. ● Identify types and purpose of structures built by kings/rulers. ● Appreciate the engineering skills and construction of monuments in medieval times and understand different types of architecture. **Stage 3: prototype to use vibration sensors** ● Realize the periodic influence on the style of architecture. ● Gain knowledge of hardware integration arduino programming and integration. ● Understand the process of data collection and labelling. ● Understand the analog vibration sensor and the theory behind it. **Stage 4: enable the hardware** ● Deduce ai modeling and its application. ● Explore python libraries like numpy, pandas, matplotlib and scikit learn.	The teacher can develop a ppt and concept map to explain the topic. A field trio with a pre planned questionnaire can be planned to any nearby historical heritage site.
Time Required	5 periods of 45 minutes each.	
Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular classroom arrangement. ● Activity Sessions – flexible (for group/pair work).	
Material Required	**Scholastic**: ● Smart Board / screen and projector ● Laptop or smart phone ● White board and marker	

	AI and Tinkering : ● Arduino UNO ● Vibration sensor ● Wires ● LED ● Power supply/Batteries ● Male/Female Jumper Wires	
Pre – Preparation Activities	**Scholastic**:: For providing learners with first-hand experience, a field trip to historical monuments is organized. **AI and Tinkering:** Check the availability of ● The Minisense 100 (vibration sensor) Account on https://machinelearningforkids.co.uk/ ● Refer to the following link https://brewminate.com/ancient-and-medieval-hindu-architecture/	
Previous Knowledge	**AI and Tinkering** The teacher prepares the learners through flipped learning methodology by sharing the following video links for the understanding and discussion of the concepts to relate to the topic to be taught in the class. ● Difference between Analog and Digital : https://learn.sparkfun.com/tutorials/analog-vs-digital/all ● Basics of Arduino : https://www.youtube.com/watch?v=nL34zDTPkcs ● Analog Read : https://www.youtube.com/watch?v=JwpBn1mPGMc ● Analog Write : https://www.youtube.com/watch?v=eVbuRAn-pZA ● Serial Print : https://www.youtube.com/watch?v=RUnUaE_hoHs ● Basics of AI and its application: https://ai-for-all.in/#/home ● Basics of AI Modeling : https://www.youtube.com/watch?v=yN7ypxC7838 ● Machine for Kids Tutorial https://www.youtube.com/watch?v=EjbHXMzeX4c&ab_channel=DaleLane	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** The teacher leads the learners into the understanding of historical monuments. **Warm-up Activity:** The teacher gives a background of historical monuments from the 8th to 18th century and discusses with them their observations of historical monuments. **Introduction:**	

	● The teacher shows a video to make the learners recapitulate their knowledge and understanding of historical monuments. https://www.youtube.com/watch?v=Rt8Xb5mJXzs ● The learners appreciate the similarities and differences of monuments built by the Hindu and Mughal rulers. **Presentation:** ● The learners make a ppt on their field trip of historical monuments and present it to share their learning. ● They discuss the evolving/ changing methods of construction/ engineering and architecture in different eras. ● The learners also understand the periodic influence on the architecture of the monuments. **Contextualization**: **AI and Tinkering**: **Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher & ATL In-charge)** **Problem Statement/Scenario:** *When students visited the historical monument, Red Fort in Delhi, they were first excited to see an old monument built in the 17th century, which still appeared very strong in the 21st century. On observing closely, they noticed the intricate stone setting turning black in places with cracks all over it. This made them feel concerned about the deteriorating condition of the monument as a heritage site.* **Empathize:** The students think deeply about the problem and ponder on it in detail. They might come up with the following points ● How do the pillars still hold the monument together, which was built in the 17th century? ● What did they notice about the intricate stone? ● What was the reason for stones turning black in places with cracks all over them? ● Is it a matter of concern for you? **Define:** Have you also noticed historical monuments in dilapidated conditions? Would you like to take up this initiative to spread awareness and be a problem-solver? Can you think together to help solve these problems of upkeep of monuments? **Ideate:** Learners will now be asked to reflect on different alternatives to resolve the issue and help preserve the monuments. **Stage 3: Prototype to use vibration sensors to predict the health of the buildings (Subject teacher and ATL in-charge).** In this activity, vibration sensors are used to predict the health of historical buildings/ monuments. **Sensor Theory :** The Minisense 100 is a low cost vibration sensor used to measure the continuous vibration or its impacts. It is highly sensitive at low frequency and is designed for easy installation. All in all, this is a perfect module for vibration or tilt sensors. **3.1 Develop hardware based on the following circuit diagram :**

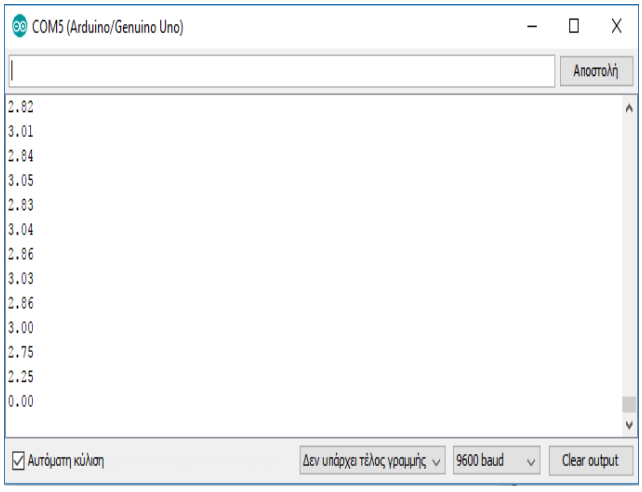


3.2 Algorithm: After connecting the hardware according to schematics, the algorithm is designed in a way to get the real time value of the vibration sensor from the building structure as well as to collect data for further analysis.

3.4 Data Collection : Following steps to be followed to make the circuit working and start collecting the data.

- Make connections according to the schematics mentioned
- Use the following code and upload it to Arduino.
  - Define the Pins through which data is collected from Arduino UNO
  - Take input from the Vibration sensor i.e. Analog Input
  - Display value for the real time analysis on serial monitor

```
int analogPin = A3; // potentiometer wiper (middle terminal) connected to analog pin 3
                    // outside leads to ground and +5V
int val = 0;  // variable to store the value read

void setup() {
 Serial.begin(9600);       //  setup serial
}

void loop() {
 val = analogRead(analogPin);  // read the input pin
 Serial.println(val);       // debug value
}
```



- Record the values of vibrations and store it in a readable format.
  https://www.ardumotive.com/piezo-vidration-sensor-en.html
  https://grobotronics.com/piezo-vibration-sensor-small-vertical.html

Stage 4: Enable the hardware developed to use the collected vibration data to predict whether the building is strong or not. (Subject Teacher, ATL Incharge)

4.1 Data Processing and understanding the Use Case :

Journey in AI begins with this step, since data has already been collected in the previous step. Making use of the data, the Use Case of the data collected is understood.

- Use Case - Use the collected vibration data to predict whether the plant is healthy or not.
- Data Processing - After understanding the Use Case, the data is cleaned and processed to make an efficient AI model.

In this section we will explore the ways that data collected from various sensors and stored in CSV files can be used in order to create an AI model.

4.2 Data Visualization: is the process of presenting the data collected in the form of a chart, diagram, picture etc. It also includes the process of cleaning the data to make it ready to be used for training a model. In order to do so the learner will go through machinelearningforkids.co.uk.

The sensor readings should be stored in a sheet as given below

Sr. No	Vibration Value
1	X
2	Z

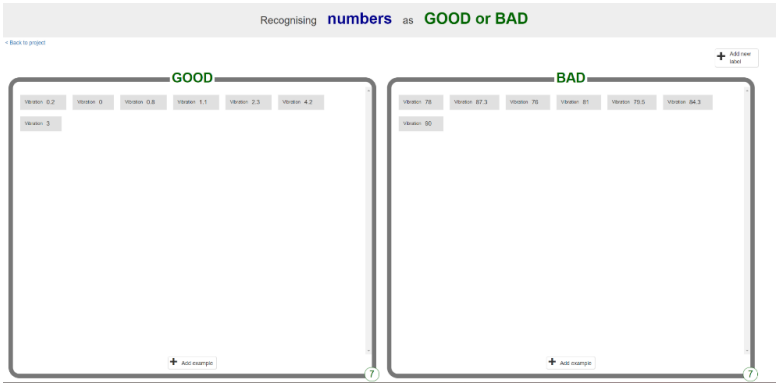
4.3 Attaining vibration values and labelling : The learner needs to make predictions based on Vibration data. In order to do that, an experiment needs to be conducted, where they note the Vibration value. Based on that, they label whether the structure is strong or not. Eg. The learner collects data from their house walls and gets the vibration levels at various time stamps, angles, which will be considered as the healthy (strong) structures of any building. Similar steps are followed for the weak structures that might be tilted or shaking structures in buildings, which will be considered as non-healthy buildings.

After adding the labels, the data might look as given below

Sr. No	Vibration value	Building Health
1	X	Good
2	Z	Bad

4.4 Data Modeling is the process of training the model on the available dataset in order to get a prediction when provided with an input.

In the present Use Case, the data is labelled for the health of the building on the basis of the vibration value. To create a data model, following steps need to be followed.

	Step 1: An account is created on the http://machinelearningforkids.co.uk website. **Step 2:** Once registered, a new project is created by clicking on "Go to your Projects Page". Next, "Add a new project" button on the top right of the screen is clicked. **Step 3:** In the details, the name of the project is specified as "Building Health". Under Recognising, numbers are selected and finally, a value as a Vibration Sensor is added **Step 4:** Next, clicking on Create option opens the Project page with three different options: ➢ Train ➢ Learn and Test ➢ Make **Step 5:** Starting by clicking on the Train option and selecting the "Add a new label" option, different labels are added: ➢ GOOD ➢ BAD **Step 6:** After creating the labels, we have to add at least 10 examples for each label. We can do this by putting the values appearing on the serial monitor for a particular type of building:  **Step 7: After** the training data is added, the 'Learn and Test' option helps train the neural network with the obtained data. This is done by selecting the 'Learn and Test' -> 'Train new machine learning model' button. **Step 8:** This will lead to testing of the neural network that has just been trained by giving it some values from the Vibration sensor and noticing if the results obtained are as expected.
Learning Outcomes	The learner ● identifies and understands the importance of historical monuments. ● appreciates the engineering skills used to build the monuments in the medieval period. ● understands different types of architecture used like 'trabeate' or 'corbelled' between 8th to 13th centuries. ● gains knowledge of two technological and stylistic developments noticeable from the 12th century – the 'arcuate' and use of Limestone cement in construction. ● verifies the facts, principles, phenomena and seeks answers to queries on their own. ● relates processes and phenomena with causes and effects, applies scientific concepts in daily life to solve problems. ● Communicates the findings and conclusions effectively and applies learning to hypothetical situations.

Glossary	• Algorithm: An algorithm is a set of instructions for solving a problem or accomplishing a task. • AI Modeling is utilizing a set of data that enables it to recognize certain patterns. This allows it to reach a conclusion or make a prediction when provided with sufficient data • This is especially useful for solving complex problems using huge amounts of data with high accuracy • Use Case: application of data collected for predicting the possible outcome. • Data Acquisition: Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that is required for the AI model. There can be various ways to collect data. • Data Exploration: Data Exploration refers to visualising the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualise the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. • Data Visualization: Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split into training set and testing set. The model is trained on the training set from which it makes its own rules that helps the machine to give an output and the model is then evaluated on the testing set. • Neural networks are loosely modelled after how neurons in the human brain behave. The key advantage of neural networks is that they are able to extract data features automatically without needing the input of the programmer. A neural network is essentially a system of organising machine learning algorithms to perform certain tasks.
Reference Links	• https://circuitdigest.com/microcontroller-projects/arduino-sw-420-vibration-sensor-module-interfacing • https://www.sparkfun.com/datasheets/Sensors/Flex/MiniSense_100.pdf • https://grobotronics.com/piezo-vibration-sensor-small-vertical.html
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability • Statistical analytics • Graphical inference **AI domain** • AI for Data

	Physical computing ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network **Social impact solution building** ● Problem identifying ● Problem scoping ● Problem solving Prototyping the AI and tinkering solution **Intrapersonal skill** ● Observation skill ● Persuasion ● Creative mindset **Interpersonal skill** ● Empathy ● Collaboration ● Leadership **Computational Thinking** ● C programming (Arduino)

Class 7
Lesson 7.4
Water - Chapter 5

Parameters	Description	Note for teachers
Chapter Covered	Chapter 5: Water	
Name of the Book	NCERT, Social Science Textbook for Class VII (Our Environment)	
Learning Objectives	We will learn about the distribution of water across the globe in this chapter, from freshwater to ocean water. ocean currents, the value of water, and practical methods for water conservation. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Understand the Water Cycle and its importance. ● Learn about the distribution of water in water bodies and understand the available amount of usable water. ● Explain how ocean waters are continuously moving unlike calm waters of ponds and lakes. ● Explain waves and factors affecting the height of the waves. ● Explain tides and how they are caused. ● Explain ocean current and its influence on the temperature conditions of the area. **AI and Tinkering** **Stage 2: Apply Design Thinking** ● Understand the Water Cycle and its importance. ● Learn about the distribution of water in water bodies and understand the available amount of usable water. ● Understand applicability of the concepts of water cycle and build solutions to provide waterflow of the dam. **Stage3: Developing hardware** ● Infer how colour water level sensing works. ● Develop algorithms to use microcontrollers with water level sensors. ● Explain how ocean waters are continuously moving unlike calm waters of ponds and lakes. ● Explain waves and factors affecting the height of the waves. **Stage 4: Making the software using AI** ● Build an AI model to predict accuracy of the sensor. **Stage 5: Making complex Modeling** ● Combine their knowledge around sensor technology with electronics and AI to create their own project.	A picture of the water cycle can be shared with students to trigger discussion or recall what they have learned in previous classes. A ppt can be developed to elaborate the topic in detail.
Time Required	5 periods of 45 minutes each	

Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – Regular classroom arrangement. ● Activity Sessions – Flexible (for group/pair work).	
Material Required	**Scholastic:** ● Smart Board/Screen and Projector ● Globe and Map ● Ziplock bag ● Burner ● Beaker ● Laptop or smartphone ● White board and marker **AI & Tinkering** ● Water level sensor ● Arduino Uno Reference for teachers: Distribution of water bodies https://youtu.be/4HSFKwho7MQ?list=PL_8hVmWnP_O258ZS4-HKumKTfX7f72LHA	
Pre – Preparation Activities	**Scholastic:** **Activity:** The teacher makes the students perform the activity 3 to 4 days before beginning the lesson. ● The learner draws the water cycle on a Ziplock bag, and adds some water to it, then tapes it to the window and observes it for a few days. **AI and Tinkering:** ● Check the availability of hardware components i. Water level sensor - to measure the water level. ii. Arduino Uno: ● Create an account on https://machinelearningforkids.co.uk/	
Previous Knowledge	**Scholastic:** The teacher shows a globe / map and initiates a whole-class discussion that three-fourth of earth's surface is covered with water and elicits from the students why the resources of water are limited and should not be wasted. The discussion helps the learners understand: ● the reason for ocean water being salty and can't be used for drinking. ● that water is a precious resource and therefore should not be wasted. **AI and Tinkering:** Basic knowledge of the following would be needed ● Programming an Arduino UNO Board. ● Sensor connections and usage. ● Acquainted with machine learning for kids website.	

	Introduction to Machine Learning for Kids Website https://www.youtube.com/watch?v=EjbHXMzeX4c	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** The teacher leads the learners into the understanding of the Water cycle. **Warm-up Activity:** ● To explain the phenomenon, the teacher performs an activity to show heating of water, which is converted into water vapours. The vapours are then cooled down, which change back into the liquid form. **Introduction:** ● The teacher shows a video to make the learners recapitulate and understand the Water Cycle. https://www.youtube.com/watch?v=ncORPosDrjI ● Use of AI tool loopy to help the learners understand the process of water cycle **Presentation:** ● The teacher refers to the pre-activity and shows the Ziplock bag to the students to explain the water cycle and its importance. ● The students observe that the water that evaporates condenses and falls back in the form of drops of water. ● The learners are able to explain different phases of the water cycle. ● The teacher holds a class discussion on the distribution of water bodies and helps learners understand its distribution as saline water and freshwater. ● The teacher further shows a video on the Ocean circulation https://www.youtube.com/watch?v=DZppjdczUpM ● The students discuss and understand the movements that occur in oceans. ● The teacher broadly categorizes ocean circulation as: waves, tides and currents and how they are caused. ● A video is then shown on the ocean currents causing a change in climatic conditions. https://www.pbslearningmedia.org/resource/ttv10.sci.ess.watcyc.currents/the-role-of-ocean-currents-in-climate/ **Contextualization**: **AI and Tinkering:** **Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher and ATL In charge)** **Problem Statement /Scenario:** *Children enjoy the monsoon season and like to play in the rains. While playing on their rooftop, Anith and Bhavik noticed the water getting collected due to debris on the cover of the drain pipe. They cleaned the debris but due to heavy rain shower, the water started flowing and overflooded the railings of the roof. They also noticed the rainwater falling down from the rooftops of most of the houses in their locality. They felt great concern at the water getting wasted as it was running down into the drains.* **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 following points:	

1. Why do you think Bhavik and Anith loved the monsoon season?
2. What were their reaction when they noticed water getting flooded and overflowing from the railings and through the walls?
3. What were they concerned to see rainwater falling down from the rooftops of most of the houses in their locality?

Define: Students are asked to reflect on the following

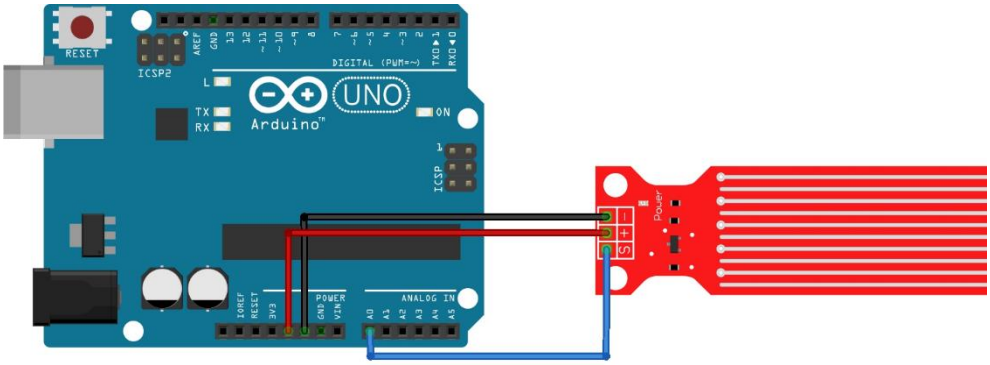
1. Have you witnessed such a situation at your home or nearby?
2. Can you think of some solution to solve this problem?

Ideate: Students will now be asked to come up with different alternatives to resolve the issue of water wastage.

Stage3: Developing hardware to sense water Level for the Dams
(Subject Teacher, ATL Incharge)

3.1 Making the Hardware:

In this module, the learners will learn to detect the water level of a Dam using a water level sensor and thereby create necessary control Connect the hardware using the following schematics



3.2 Algorithm

After connecting the hardware according to the schematic, the learners make an algorithm on which the programming will be based.

Following steps to be followed to understand the key steps and their structure:

Step 1: Data Collection: In order to understand and thereafter control the dam supply, the learner needs to know the water level of the dam.

- Defining the Pins through which data is collected from Arduino UNO.
- Take Input from Analog pH sensor.
- Store the values in variables.

Step 2: Data Processing: The data collected is in the raw stage and needs to be processed for further understanding and analysis. Process the data received from water level sensor

Step 3: Data Transfer: Once the data is processed, it is transferred to the system through serial communication using USB Cable.

- Store all the processed data to be transferred in a String.
- Send the data using Serial Communication every time the water level crosses the threshold.

```
/* Change these values based on your calibration values */
int lowerThreshold = 420;
int upperThreshold = 750;

// Sensor pins
#define sensorPower 7
#define sensorPin A0

// Value for storing water level
int val = 0;

// Declare pins to which LEDs are connected
int redLED = 2;
int yellowLED = 3;
int greenLED = 4;

void setup() {
        Serial.begin(9600);
        pinMode(sensorPower, OUTPUT);
        digitalWrite(sensorPower, LOW);

        // Set LED pins as an OUTPUT
        pinMode(redLED, OUTPUT);
        pinMode(yellowLED, OUTPUT);
        pinMode(greenLED, OUTPUT);

        // Initially turn off all LEDs
        digitalWrite(redLED, LOW);
        digitalWrite(yellowLED, LOW);
        digitalWrite(greenLED, LOW);
}

void loop() {
```

```
        int level = readSensor();


        if (level == 0) {
                Serial.println("Water Level: Empty");
                digitalWrite(redLED, LOW);
                digitalWrite(yellowLED, LOW);
                digitalWrite(greenLED, LOW);
        }
        else if (level > 0 && level <= lowerThreshold) {
                Serial.println("Water Level: Low");
                digitalWrite(redLED, HIGH);
                digitalWrite(yellowLED, LOW);
                digitalWrite(greenLED, LOW);
        }
        else if (level > lowerThreshold && level <= upperThreshold) {
                Serial.println("Water Level: Medium");
                digitalWrite(redLED, LOW);
                digitalWrite(yellowLED, HIGH);
                digitalWrite(greenLED, LOW);
        }
        else if (level > upperThreshold) {
                Serial.println("Water Level: High");
                digitalWrite(redLED, LOW);
                digitalWrite(yellowLED, LOW);
                digitalWrite(greenLED, HIGH);
        }
        delay(1000);
}
//This is a function used to get the reading
int readSensor() {
        digitalWrite(sensorPower, HIGH);
        delay(10);
        val = analogRead(sensorPin);
```

```
    digitalWrite(sensorPower, LOW);

    return val;

}
```

The hardware developed will be able to detect the water level by using a water level sensor.

Stage 4: Making the software using AI for the hardware developed
(Subject Teacher, ATL Faculty)

4.1 Importing data from Hardware

In the previous section, a hardware prototype was made using the following components:

- Water level sensor - to measure the water level.
- Arduino Uno: to collect data from the sensors and control them.
  - Once the hardware is set up, data is collected from the sensors at regular intervals.

Steps to use data:

The first and the foremost step is to store this data. In order to do so, the data must be captured from the serial monitor and stored in a csv (comma separated values) file for further usage. The learner notes down the values in the csv by measuring from the arduino.

4.2 Data Exploration

Once the data acquisition part of the AI Project cycle is complete, the next stages are Data Exploration.

After introduction to the hardware of the IR sensor and the production object, the next step is to create a model which can predict the accuracy based on the above parameters. In this section the learner explores the ways the data collected from various sensors and stored in a CSV file can be used in order to create an AI model. **Students** create a labelled dataset which can be used to train the model for classifying the accuracy of water level as per the analog data.

This can be done by deliberately using glasses with different water levels:

- Option 1: Glass with half filled water
- Option 2: Glass with water filled till full level
- Option 3: Empty glass

The data captured after following either of the above-mentioned steps needs to be labelled as per the labels: Over-Threshold or Below-Threshold.

An example of the data is given below. (Threshold=750)

Stage	Water level data	Label
Empty	0	0
Half water	500	0

Here,

0 – Below-Threshold

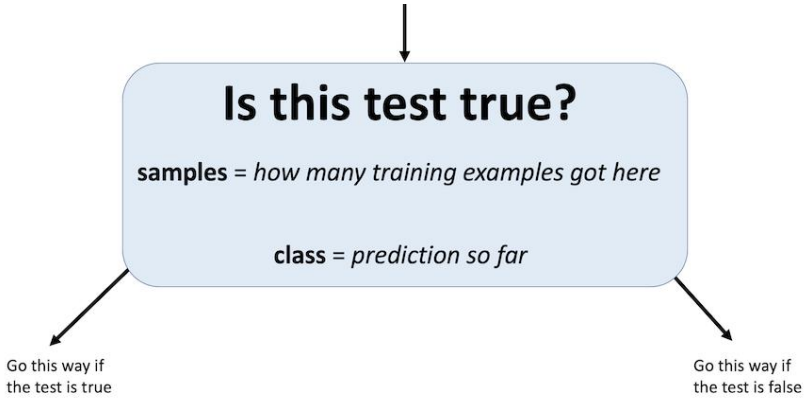
1 – Over-Threshold

You will need to label the data captured in this manner in order to make it ready for training a model.

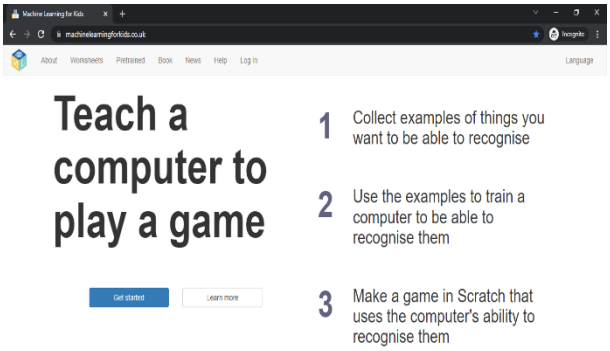
Stage 5: Making complex Modeling technique for AI-enabled software (Subject teacher and AI Faculty)

In the previous stage, it started with taking the water level measurements in order to control the water flow of the dam.
To take this forward, the next step is to try complex Modeling techniques on the same data set and compare the performance of both models. The method is explained as follows

- To train a model based on the data fetched from the sensor, a tool to work on the water level dataset will be used. The technique used to create the machine learning model is called a Decision Tree Classifier.
- This is not the only way to train a machine learning model. It is being used as it is very quick and easy to train, and it is one of the easiest techniques to understand. This page shows the decision tree that was created based on the training examples collected by the learners.
- When the learners test their model, the computer starts at the top of the tree, and follows a path until it reaches the bottom. The class at the bottom of the tree is the prediction that the machine learning model makes.
- At each box in the tree, it reads the test described at the top of the box. If the test values of the learners pass the test described in the box, it follows the arrow to the left. If it doesn't pass the test, it follows the arrow to the right.

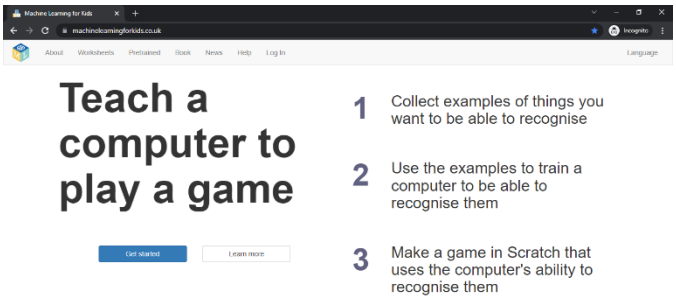


- The samples are shown in each box show how many examples in the learner's training data match that part of the decision tree.
- The value shown in each box shows how many examples in the learner's training data passed the test shown at the top (following the left arrow) and how many examples didn't pass the test at the top (following the right arrow).
  Machine Learning for Kids - This tool will help learners train their model with their own dataset, thereby leading them to their results very easily.



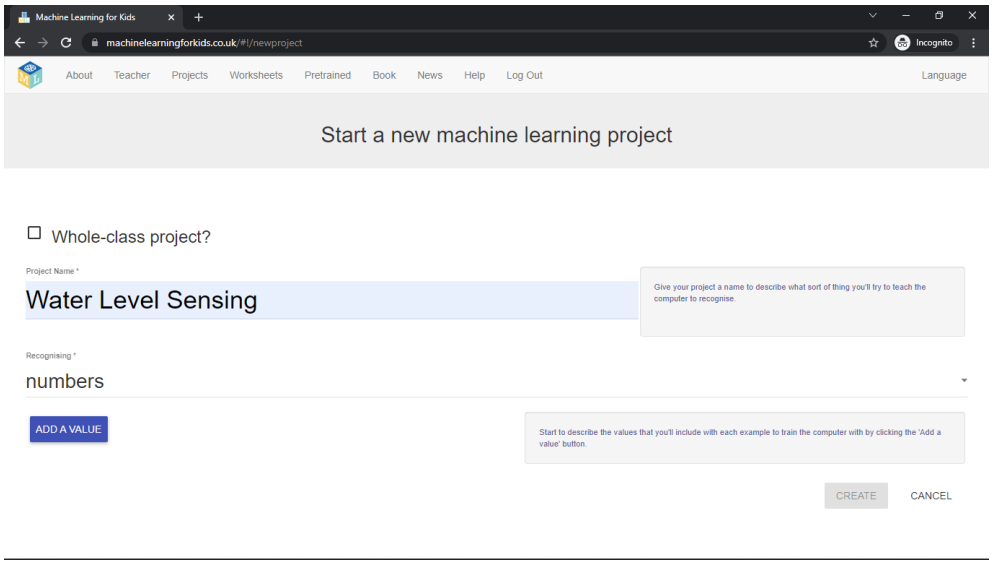
Steps to develop the Modeling technique

5.1 Get started > Go to projects

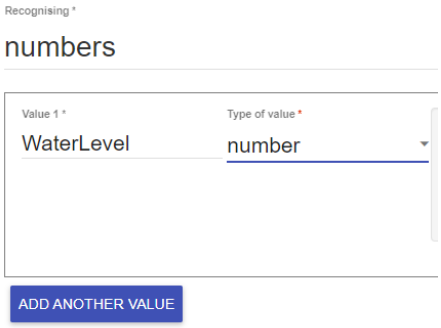


5.2 Add new project

5.3 Project Name: **Water Level Sensing**, Type: **Numbers** (as the water level data is analog & in numbers)

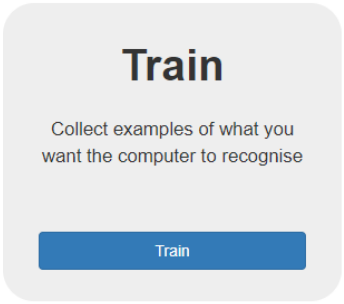


5.4 Add a value: **WaterLevel**, type of value: **number**



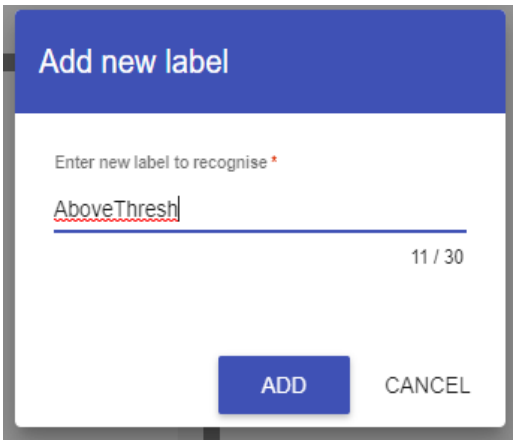
5.5 Create the project

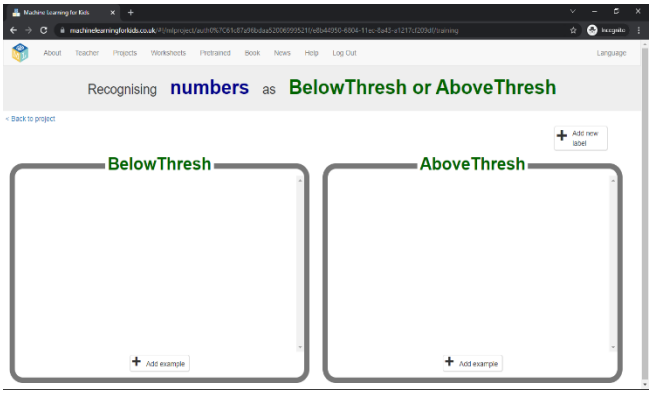
5.6 Train the project model



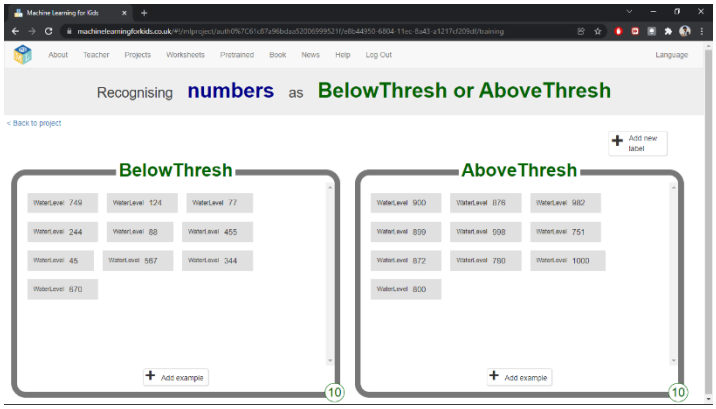
5.7 Add new Label to the training model

- Label-1: BelowThresh (For determining the water levels below the threshold set)
- Label-2: AboveThresh (for classifying the water levels above the threshold value.

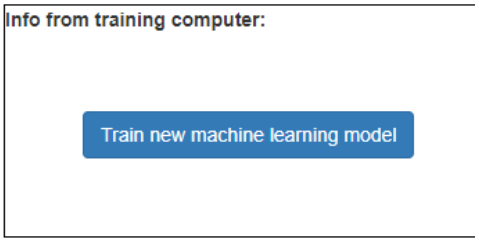


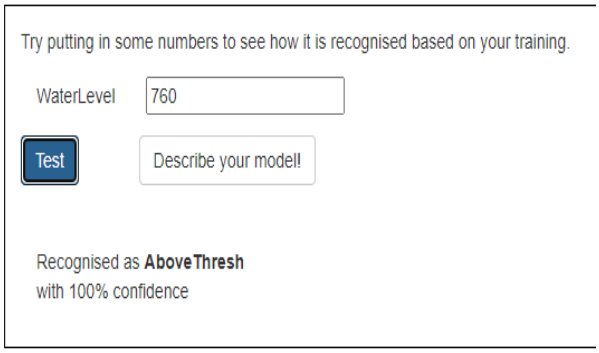


5.8 Add examples to each of the labels. The examples are the data gathered from the water level sensor and labelled as above threshold and below threshold.



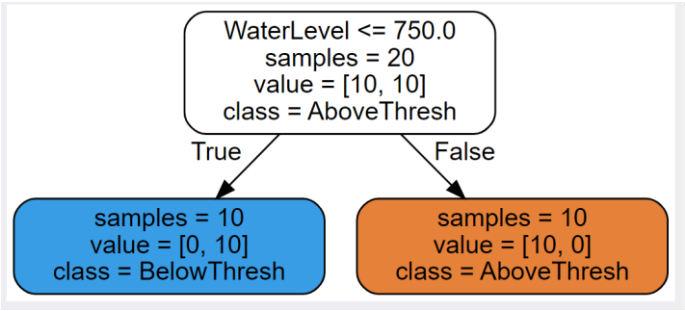
5.9 Now Test the dataset that has been added to the training model.





5.10 Explore the tool and make something cool with it.

UNDERSTANDING OF THE MODEL DEVELOPED:

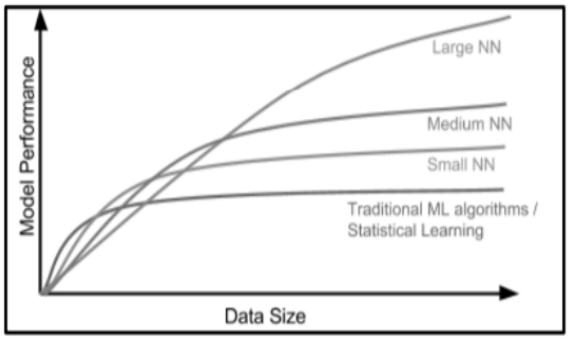


5.11 Observation:

After the model is trained, the prediction of water level is received using Machine learning for kids tool.

It is observed that the performance of both the models is different. The next step is to try and check the performance of the model by increasing the amount of data.

This is to observe that the performance of the model varies as per the amount of data used for training a model. The relation between the model performance and data size varies as per the below mentioned graph.



Must Try: One can try changing the dataset size and map it with the performance of the models.

Learning Outcomes	The learner ● identifies and understands the water cycle and its importance for life on Earth. ● comprehends the distribution of water bodies and why water should not be wasted or polluted. ● relates with water pollution in real life situation and suggests measures to prevent pollution ● understands the formation of waves, tides and ocean currents and their effect on climate. ● understands the cause of high tides and their benefits. ● verifies the facts, principles, phenomena and seeks answers to queries on their own. ● relates processes and phenomena with causes and effects, applies scientific concepts in daily life to solve problems. ● communicates the findings and conclusions effectively and applies learning to hypothetical situations.
Glossary	● **Water Level Sensor:** The water sensor or water level sensor is used to detect water leakage, rainfall, tank overflow, or to measure the water level. ● **Digital Signals:** A digital signal, on the other hand, has only two values: HIGH and LOW. ● **Analog signals:** An analog signal is one that can take on any number of values, unlike a digital signal which has only two values: HIGH and LOW. ● **The decision tree classifier** creates the classification model by building a decision tree. Each node in the tree specifies a test on an attribute, each branch descending from that node corresponds to one of the possible values for that attribute. ● **Data Acquisition:** Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that is required for the AI model. There can be various ways to collect data. ● **Data Exploration**: Data Exploration refers to visualising the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualize the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. ● **Data Visualization:** Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split into the training set and testing set. The model is trained on the training set from which it makes its own rules that helps the machine to give an output and the model is then evaluated on the testing set.
Skill outcomes	**Tech skill** ● Digital learning ● Algorithmic thinking ● Data gathering ● Pattern recognition ● Model optimization **Design thinking** ● Ideation ● Prototyping **Mathematical and quantitative skills** ● Probability ● Statistical analytics ● Graphical inference

	AI domain ● AI for Data **Physical computing** ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network **Social impact solution building** ● Problem identifying ● Problem scoping ● Problem solving Prototyping the AI and tinkering solution **Intrapersonal skill** ● Observation skill ● Persuasion ● Creative mindset **Interpersonal skill** ● Empathy ● Collaboration ● Leadership **Computational Thinking** ● C programming (Arduino)

Class 8
Lesson 8.1
Combustion and Flame - Chapter 6

Parameters	Description	Note for teachers
Chapter Covered	Chapter 6: Combustion and Flame	This Lesson Plan essentially is to enable students to tinker on Topic 6.2 - *'How Do we Control Fire?'* from Chapter 6: *Combustion and Flame*, NCERT, Science Textbook of Class VIII.
Name of the Book	NCERT, Science Textbook for Class VIII	
Learning Objectives	This chapter aims at imparting knowledge on the chemical process of burning and the necessary requirement for creating fire. In order to avoid or stop an accidental fire, timely identification of fire is extremely critical. This lesson plan aims at ideating and designing automated devices that can identify an accidental fire and inform the concerned authorities for taking timely action. To enable learners to **Stage 1: Conceptualization** ● Recognize the essential requirements to create a 'Fire Triangle'. ● Differentiate between various types of accidental fire. ● Identify the role of extinguishers in breaking the fire triangle. **AI and Tinkering:** **Stage 2: Contextualisation by applying design thinking framework** ● Understand how AI can be used to predict forest fires. ● Use a camera to detect a flame. **Stage 3: Developing image-based AI model to predict fire based on image data** ● Use www.machinelearningforkids.co.uk website to create an image based project. ● Download the program that predicts/evaluates whether fire has taken place or not. **Stage 4: Introduction to automated fire fighting device** ● Understand the circuitry that enables starting of a motor ● Draw nexus between arduino board, its programming and the motor operations ● Programming the arduino to trigger the motor	

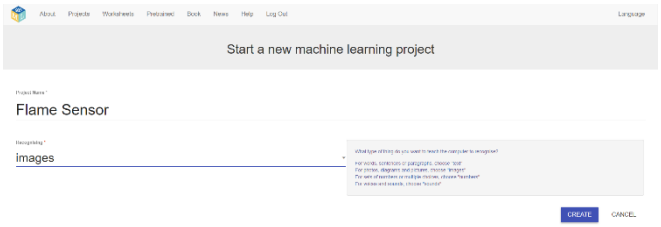
	Stage 5: Identification of an ongoing wildfire ● Develop a fire extinguishing prototype ● Make use of prediction made by AI model (stage 3) to activate or deactivate a water pump.	
Time Required	4 periods of 45 minutes each.	
Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular classroom arrangement. ● Activity Sessions – Flexible (for group/pair work).	
Material Required	**Overall:** ● Smart Class setup/ projector and speaker ● Whiteboard and marker ● Computers with webcam (3 students :1 computer) ● Good internet connectivity **For Stage 2 & 3 Activity:** ● Arduino UNO ● Arduino adapter ● Arduino connector cable ● Water pump ● Relay ● Jumper wires ● Power supply	
Pre – Preparation Activities	● To help learners understand the role of oxygen in combustion, a live demonstration of Activity 6.2 from the textbook shall be conducted, or the learners can be asked to perform the activity at home in presence of their parents. ● To explain the role of temperature, the teacher will demonstrate activity 6.5 from the textbook, by burning two identical paper cups, one empty and one filled with water using a burner. The temperature of the water before and after a few minutes (say 6 minutes) can also be recorded for reference. ● Teacher to keep the following links ready before class demonstration: **Accidental Fire video:** https://www.youtube.com/watch?v=whlymAuRtzU&ab_channel=HomeFireSprinklerCoalition	
Previous Knowledge	The learner understands the concept of: **Scholastic:** ● combustion ● combustible substances/fuel ● role of oxygen as a supporter of fire	

Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** The teacher will conduct the first session in a regular classroom set up and cover the following topics: ● Key requirements for a Fire and explain the concept of the Fire Triangle. ● Applications of fire. ● Potential fire hazards in different situations leading to accidental fire, especially at home. ● Video on accidental fire, to help identify the extinguisher used and the type of fire https://www.youtube.com/watch?v=whlymAuRtzU&ab_channel=HomeFireSprinklerCoalition (Hint: The Fire Triangle) ***The teacher can show a powerpoint presentation on 'fire triangle' and explain the use of fire extinguishers in breaking the fire.*** **Contextualization**: **AI and Tinkering**: **Stage 2: Apply Design Thinking framework*(refer to chapter 2.1 for details on the Design thinking Framework)* and develop an AI model to detect the presence of forest fire (Subject Teacher and AI teacher).** **Problem Statement / Scenario:** *Today was Khushboo's English exam for the Class 10 CBSE board examinations. It was also the last examination of the Board exam series, after which she and her family were finally bound for an amazing holiday. Khushboo had always heard of the untouched beauty of North-East India so her father had gifted her a 10-day vacation to Mizoram.* *While attempting her English exam, Khushboo read a comprehension passage, which talked about forest fires in India. According to the passage, March-April was the month when most wildfires took place, citing that, north-east Indian forests were most prone to such hazards. This piece of information alarmed Khushboo. She started having second thoughts about her trip.* **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. Why is Northeast India called the land of untouched beauty? 2. Which states comprise the North-Eastern Indian states? 3. Khushboo was super excited about her trip to Mizoram. Which of her qualities is depicted from her excitement? (Hint: she is a nature lover) 4. Why do most wildfires take place during the months of March-April? 5. Why are North-eastern states risk-prone to wildfires? 6. Why did Khushboo get alarmed after reading the passage? **Define**: Ask learners to identify several reasons behind the spread of wildfires based on the current cases worldwide. Share with them the concept of AI and how AI is being used to solve social problems. Ask them if there exists a possibility to use Artificial Intelligence to detect the presence of a forest fire? **Ideate:** Learners identify ways in which Artificial Intelligence can be used to detect forest fires. Post brainstorming, the teacher introduces them to an image-based AI model that can predict if the forest fire is present or absent based on image data. Here are the steps:

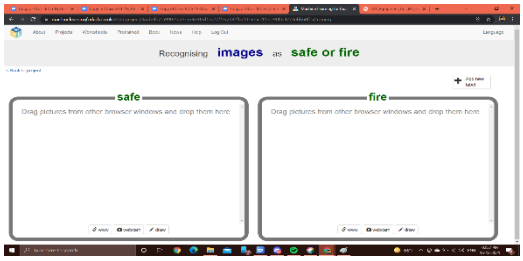
Stage 3: Developing image-based AI model to predict fire based on image data (Subject Teacher and AI Faculty)

3.1 Go to www.machinelearningforkids.co.uk and create a project with a name 'Flame sensor'.

3.2 Choose the project to work with images.

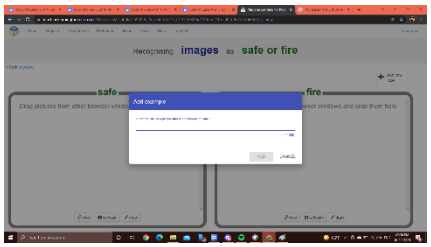


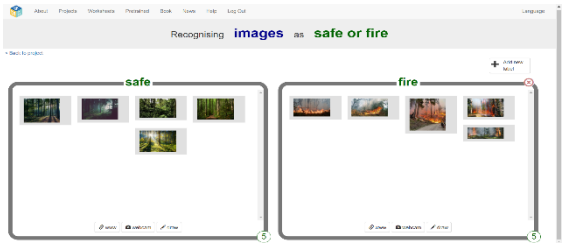
3.3 Create two labels under it: fire and safe.



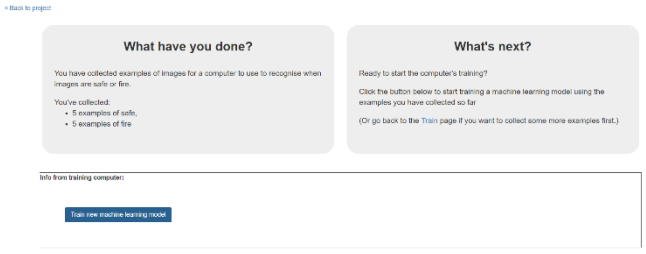
3.4 Now, search from google, images depicting forests with and without fire. Download at least 10 such images for each case.

3.5 Then upload no fire images under safe label and forest fire images under fire.

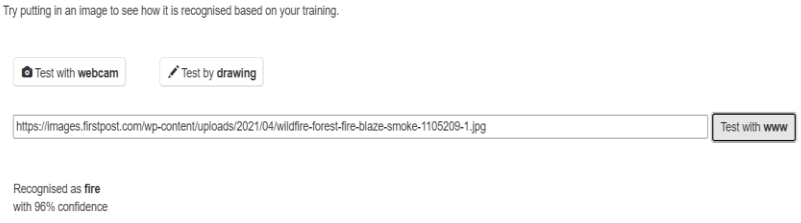




3.6 After adding images under each label, we move to learn and test.



3.7 Clicking on "Train new machine learning model", gives us a working AI module that predicts the presence of fire based on images.



3.8 Now, go to Make> Python and follow the steps mentioned there to download your project for 64-bit version of Python.

3.9 After completing all the steps, copy the code given on the website, open Python IDE on your system and paste as a new program.

3.10 Now, download some more images that will be used to test the AI model. Whichever you wish to feed into the model, rename that image as "my-test-image.jpg" and move it to the same folder as your project code.

3.11 Finally, you have an AI model that can predict the presence of fire in forests.

Stage 4: Introduction to automated firefighting device (Subject teacher and ATL in-charge)

Empathize: The learners will now reflect on the scenario:

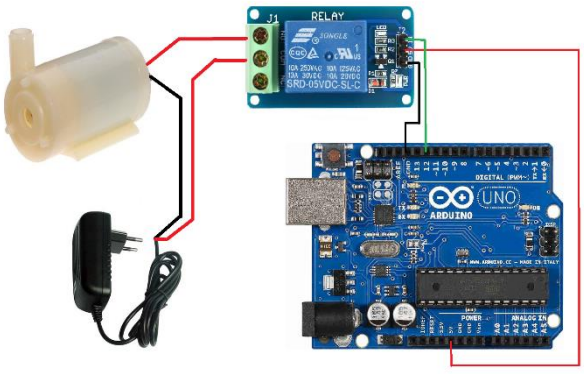
1. Why are forest fires called wildfires?
2. Is it humanly possible to control an ongoing wildfire?
3. Can the exact source of wildfires be detected, without putting lives at risk?

Define: Ask learners to identify methods used by firefighters to put the fire out.

Ideate: Ask learners to think of methods to develop a firefighting device that automatically gets triggered when the fire is detected. Here is one way to develop an automatic fire extinguisher circuit.

(learners can come up with other models also):

4.1 Here is the schematic diagram of the circuit:



4.2 After making the connections, upload the following code in the Arduino

```
int x;
void setup() {
 pinMode(12,OUTPUT);
 Serial.begin(115200);
 Serial.setTimeout(1);
}
void loop() {
 while (!Serial.available());
```

```
 x = Serial.readString().toInt();
digitalWrite(12,x);
}
```

4.3Now, based on the readings that appear on the Serial monitor, the pump gets triggered. Thus, if the readings indicate the presence of fire, the pump turns on to extinguish the fire

4.4 The readings can directly be taken from the AI model we created previously to indicate the presence of fire based on the image data.

Stage 5: Identification of an ongoing wildfire (Subject teacher and AI Faculty)

Empathize: The learners will now reflect on the scenario:

1. Can wildfires be controlled if identified on time?
2. What are the success rates of such measures in North-East India?

Define: Ask learners to brainstorm about the identification of the location of an ongoing wildfire and implement timely action to reduce loss of property and life.

Ideate: Ask learners to combine stage 1 and stage 2 to develop an automatic fire extinguisher enabled with Artificial Intelligence. Here are the steps to do so:

5.1 Install the OpenCV package for Python using this command

pip install opencv-python.

5.2 Once the library is installed, add the following code to take pictures from the video feed of the webcam.

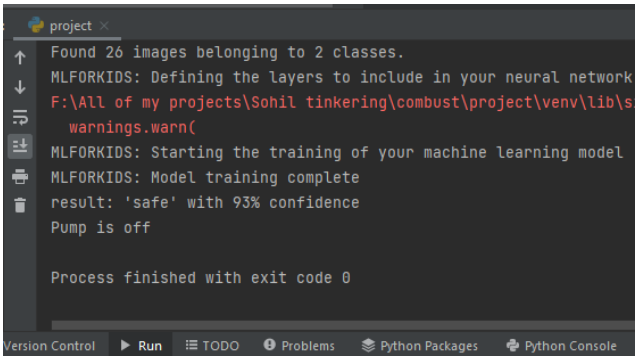
```
import cv2
import time

videoCaptureObject = cv2.VideoCapture(0)
result = 0
while(result<2):
  time.sleep(2)
  ret,frame = videoCaptureObject.read()
  cv2.imwrite("my-test-image.jpg",frame)
  result += 1
videoCaptureObject.release()
cv2.destroyAllWindows()
```

5.3 The final code will look like this:

```
import cv2
import time

import serial
arduino = serial.Serial(port='COM22',
baudrate=115200, timeout=.1)

# treat this key like a password and keep it secret!
```

```
from mlforkids import MLforKidsImageProject

key = "Insert-API-Key"

videoCaptureObject = cv2.VideoCapture(0)
result = 0
while(result<2):
  time.sleep(2)
  ret,frame = videoCaptureObject.read()
#   cv2.imwrite("my-test-image.jpg",frame)
  result += 1
videoCaptureObject.release()
cv2.destroyAllWindows()

# this will train your model and might take a little
while
myproject = MLforKidsImageProject(key)
myproject.train_model()

# CHANGE THIS to the image file you want to
recognize
demo = myproject.prediction("my-test-
image.jpg")

label = demo["class_name"]
confidence = demo["confidence"]

# CHANGE THIS to do something different with
the result
print ("result: '%s' with %d%% confidence" %
(label, confidence))

if label=="fire" and confidence>=90 :
  arduino.write(bytes("1", 'utf-8'))
  print("Starting Pump")
elif label=="safe" or confidence>=90:
  arduino.write(bytes("0", 'utf-8'))
  print("Pump is off")
```

5.4 To test the system in real-time, run the program and capture an image. The code will then analyze it, and send data to the Arduino, which will turn a pump motor on or off based on the data provided by the python sketch.

	
Learning Outcomes	The learners will be able to **Scholastic:** • conduct simple investigations to seek answers to the requirements of creating fire. • relate the Heat Transfer phenomenon with increased time to catch fire. • apply the learning of fire triangle in taking precautions for fire hazards or right actions to combat accidental fire. **Tinkering:** • understand the applicability of the concepts of the physics and chemistry of combustion. • understand how to use the webcam as a flame detector. • understand how to create a machine learning program that can sense things. • develop a python code that reads an image. • control an Arduino using the serial monitor.
Glossary	• **Machine Learning for kids**: An educational tool for teaching kids about machine learning, by letting them train a computer to recognize text, pictures, numbers, or sounds. • **OpenCV: (Open Source Computer Vision Library)** is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in commercial products. • **Machine learning** is a subfield of artificial intelligence, which is broadly defined as the capability of a machine to imitate intelligent human behavior. Artificial intelligence systems are used to perform complex tasks in a way that is similar to how humans solve problems. • **Data Acquisition**: Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that are required for the AI model. There can be various ways to collect data. • **Data Exploration**: Data Exploration refers to visualizing the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualize the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. • **Data Modeling**: Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split into a training set and a testing set. The model is trained on the training set from which it makes its own rules that help the machine to give an output and the model is then evaluated on the testing set.

	• **Arduino Uno:** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins and 6 analogy-input pins which can be used to control a large variety of input and output devices such as displays, sensors, buttons and motors. • **Relay module**: A 5v relay is an automatic switch that is commonly used in an automatic control circuit to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V. • **DC Pump**: A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action, typically converted from electrical energy into hydraulic energy.
Reference Links:	• How to capture an image using opencv: https://www.studytonight.com/post/capture-videos-and-images-with-python-part2 • How to send data from a python program to Arduino: https://create.arduino.cc/projecthub/ansh2919/serial-communication-between-python-and-arduino-e7cce0 • Burning of dry and fresh leaf https://www.youtube.com/watch?v=qtcrWoueEJw&ab_channel=MriduPrakashSaxena • Heating Water in a Paper Cup activity https://www.youtube.com/watch?v=YZI7O0nogzQ&ab_channel=NCERTOFFICIAL • Fire Hazard at home https://www.youtube.com/watch?v=QTkYkNRJyHk&ab_channel=FireandRescueNSW
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability **AI domain** • AI for Computer Vision **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Creative mindset **Interpersonal skill** • Empathy • Collaboration **Computational Thinking** • C programming (Arduino)

Class 8
Lesson 8.2
Pollution of Air and Water - Chapter 18

Parameters	Description	Note for teachers
Chapter Covered	Chapter 18: Pollution of Air and Water	This Lesson Plan shall be taken up when teaching about *Air Pollutants* and Section 18.3 – *Case Study – The Taj Mahal?* From Chapter 18 - Pollution of Air and Water, NCERT, Science Textbook of Class VIII
Name of the Book	NCERT, Science Textbook for Class VIII	
Learning Objectives	This chapter covers all the aspects of pollution. Many a times, pollutants make way to the soil, and disturb the soil ph, which is one of the most important factors affecting the plant growth. This in turn influences the crop yield. Here, learners will be asked to think of ways to identify and rectify the nature (acidic/basic) of the soil using natural indicators and commonly available chemicals respectively. To enable learners to **Scholastic:** **Stage 1: Conceptualization** ● Learn about the effects of air pollution on non-living things. ● Reason for the discoloring of natural white marble of the Taj Mahal. ● Realize the various pollutants/factors behind 'Marble Cancer'. ● Analyze the occurrence of acid rain in the present day. ● Identify various measures taken by govt. Authorities to reduce air pollution. **AI + Tinkering:** **Stage 2 : Contextualization by applying Design Thinking framework** ● Identify the nature of soil using natural indicators and commonly available chemicals. ● Try different methods to reverse the acidity of soil **Stage 3: Develop ph monitor** ● Learn how to use a colour sensor. ● Understand how to develop a ph monitor **Stage 4: AI integration with the ph sensor for automatic identification of soil's acidic or basic conditions** ● Model an AI tool on deciphering ph scale to acidic and basic conditions. ● Develop an easy-to-use AI-enabled ph monitor.	
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/ projector and speaker ● Computer (1 system for 5 students) ● Good internet connectivity ● Fresh garden soil ● Acidic Soil ● Acidic and Basic readily available chemicals ● Litmus paper **For Stage 2 & 3:** ● Arduino UNO ● Arduino power adapter ● Arduino connector cable ● TCS3200 Colour Sensor ● Jumper Wires ● pH paper strips ● Glass slides ● Dropper optional ● Colour paper ● Cardboard ● Black Paper ● Cello tape ● Glue	
Pre – Preparation Activities	**Keep the following links ready before the session:** ● **Article on the usage of marbles in home furnishing**: https://www.livspace.com/in/magazine/renovating-vitrified-tiles-vs-marble-quest-for-the-better-flooring-option/ ● **Explore the following tool for a virtual tour to several historical monuments:** https://artsandculture.google.com/ ● **Picture gallery for Taj Mahal:** https://miro.medium.com/max/1300/1*5H31O9b6S73qH5TkhysMMQ.jpeg ● **The teacher can show a youtube video on Taj Mahal Discolouration from the link :** https://www.youtube.com/watch?v=qS8Cc9Bdum8 ● **Video on Acid Rain:** https://www.youtube.com/watch?v=1PDjVDlrFec&t=29s&ab_channel=NationalGeographic ● **Acid Rain equations explained:** https://www.youtube.com/watch?v=k9CK5lE5ieA **For the tinkering activity teacher should try the entire activity with support from ATL in-charge and ensure the availability of required materials.**	

	• **Watch the video on Arduino Colour Sensing Tutorial - TCS230 TCS3200 Colour Sensor:** https://www.youtube.com/watch?v=CPUXxuyd9xw&t=249s&ab_channel=HowToMechatronics • **Teacher explore the following platform.** http://machinelearningforkids.co.uk and execute the entire. activity with support from ATL in-charge and AI teacher.	
Previous Knowledge	Knowledge of pH	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** To begin with this topic, the Teacher will conduct a session in regular classroom setup and: • Ask the learners who have marble flooring at their home and discuss the advantages and disadvantages of using it.(Hint: it is a natural and cold stone, maintenance cost of Marble is rather high, in comparison to tiles). https://www.livspace.com/in/magazine/renovating-vitrified-tiles-vs-marble-quest-for-the-better-flooring-option/ • Take learners on an e-tour of famous monuments, for example Taj Mahal (priority), Fatehpur Sikri, Thomas Jefferson Memorial etc, via Google Arts and Culture App on the web Browser: https://artsandculture.google.com/ • Learners will observe pictures of Taj Mahal to recognize and discuss the discoloration over the years thereby explaining what Marble Cancer is. https://miro.medium.com/max/1300/1*5H31O9b6S73qH5TkhysMMQ.jpeg • Learners will watch this video on Acid Rain: https://www.youtube.com/watch?v=1PDjVDIrFec&t=29s&ab_channel=NationalGeographic • Learners then write the chemical equations that define acid rain formations and conclude by reiterating the factors causing the discolouring of the Taj Mahal and other ill-effects of acid rain and watch this video: https://www.youtube.com/watch?v=k9CK5lE5ieA **Contextualization**: **AI and Tinkering:** **Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario and Design pH sensor for identifying acidic or basic nature of the soil (Subject teacher and ATL in charge).** **Problem Statement / Scenario:** *Chandan is a fourth-generation farmer. Unlike his father who is a traditionalist, Chandan took help of the modern agricultural practices, owing to which his crop produce started increasing over the years. He even supported the installation of various industries in his village, which eventually brought employment and prosperity to his village. But since the last 2 years, Chandan has started observing stunted plant growth, and decreased yield. Earlier he thought it was the bad quality of seeds or infertility of the soil, but when he got his soil tested, it indicated the soil to be in extremely acidic conditions. Chandan had been doing everything exactly the same way, but what went wrong this time?*	

The Teacher will now apply the design thinking framework on Chandan's 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. Unlike his father, why did Chandan choose a modern approach towards agriculture?
2. What is wrong with being a traditional agriculturist? (Hint: intensive farming)
3. Do you happen to know any farmer who thinks like Chandan?
4. Do you think whether soil exhibits any optimal pH or not at all? (Hint: yes, Soil exhibits pH [range 0 to 14], and an optimal soil pH is a prerequisite for healthy plant growth, and it varies from plant to plant)
5. Can the air quality of the village be influenced by the industrial setup?
6. Do you think Chandan's father will understand the theory behind soil-pH?
7. Will the farmers benefit if the soil-pH scale is made easy to understand for all?
8. Chandan is an educated farmer. Do you think Chandan will be able to perform soil-pH tests using natural indicators or universal indicators?

Define: Ask learners to answer the following questions:

1. What are the possible reasons behind the acidic or basic conditions of the soil? (Hint: overuse of fertilizers, Poor drainage, industrial effluents mixing in water bodies and used for irrigation, improper soil preparation, or acid rains due to industrial setup).
2. If soil pH is not favourable for plant growth, what should be done?
3. Is the current method to determine pH levels easy to conduct for anyone?
4. Does a person need to have previous knowledge about pH and the testing apparatus before conducting the experiment?
5. How to make the pH testing process simple enough for anyone, anywhere?

Ideate: The learners will be asked to think of ways to identify and rectify the nature of soil using natural indicators and commonly available chemicals respectively. They will also have to brainstorm on several possible solutions and discuss the advantages and disadvantages while comparing them (keeping in mind the solution needs to be simple enough to be operated by anyone, anywhere).

Activity 1: Preparation of a homemade pH indicator.

- Learners come up with several out of the box solutions to develop their own pH indicators at home and bring them to class.
- Teacher to get some fresh garden soil for learners to test its pH level with their homemade indicators. The results of this activity are then compared with results achieved by testing the soil's pH using universal pH indicators (litmus paper, etc.)

Activity 2: Teacher to provide an acidic soil sample (made acidic with vinegar) and learners are asked to:

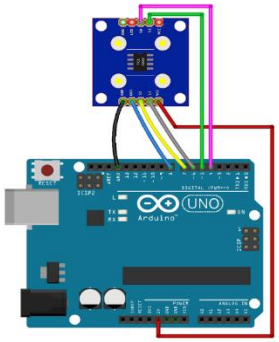
1. Test the pH of soil
2. Check if the acidic nature of the soil is reversible or not

3. Try different methods to reverse the acidity of soil using various commonly used chemicals (e.g. soda water, shampoo, tap water, calcium hydroxide, vinegar, milk, dishwashing liquid soap etc).

Stage 3: Develop pH monitor in the ATL lab (Subject Teacher and ATL In-charge)

Learners develop their own pH monitor in the ATL Lab with the help of ATL in-charge.

3.1 Following connections are to be made between Arduino UNO and TCS3200 colour sensor:



3.2 For the apparatus to work optimally, the colour sensor is to be put in a box with a lid. Learners may create an opaque box out of black paper or cardboard to ensure the light does not go out of the box. The box should ideally look like this:

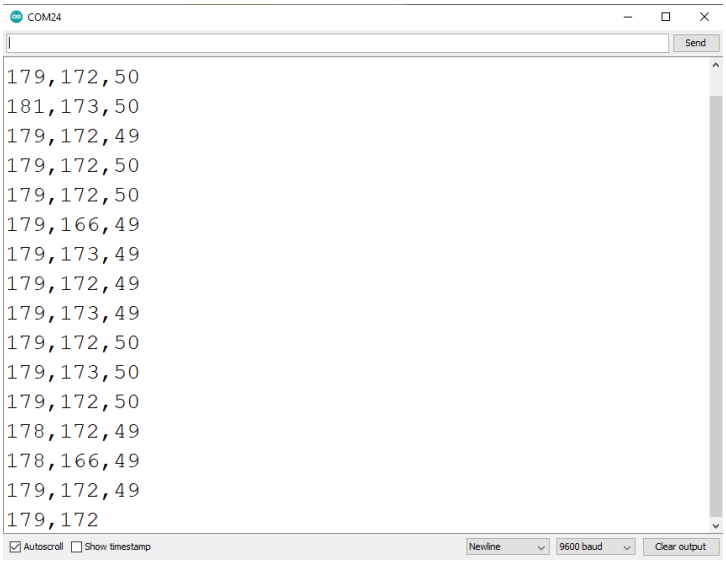
From top to bottom, we have the slide holder, the glass slide for putting the pH paper on, and the lid with the sensor and the LEDs of the sensor cut out through the lid.

3.3 Once the box is ready and the connections are made as shown above, learners put the code given below in Arduino UNO:

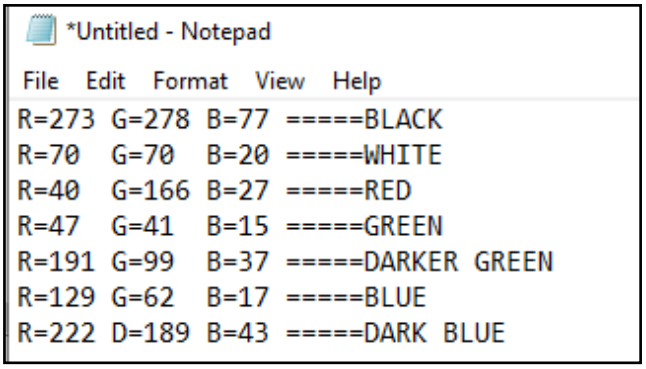
```
#define S0 4
#define S1 5
#define S2 7
#define S3 6
#define sensorOut 8
int frequency = 0;
void setup() {
 pinMode(S0, OUTPUT);
 pinMode(S1, OUTPUT);
 pinMode(S2, OUTPUT);
 pinMode(S3, OUTPUT);
 pinMode(sensorOut, INPUT);
```

```
 // Setting frequency-scaling to 20%
 digitalWrite(S0,HIGH);
 digitalWrite(S1,LOW);

 Serial.begin(9600);
}
void loop() {
 // Setting red filtered photodiodes to be read
 digitalWrite(S2,LOW);
 digitalWrite(S3,LOW);
 // Reading the output frequency
 frequency = pulseIn(sensorOut, LOW);
 // Printing the value on the serial monitor
 Serial.print(frequency);//printing RED color frequency
 delay(100);
 // Setting Green filtered photodiodes to be read
 digitalWrite(S2,HIGH);
 digitalWrite(S3,HIGH);
 // Reading the output frequency
 frequency = pulseIn(sensorOut, LOW);
 // Printing the value on the serial monitor
 Serial.print(",");//printing name
 Serial.print(frequency);//printing RED color frequency
 delay(100);
 // Setting Blue filtered photodiodes to be read
 digitalWrite(S2,LOW);
 digitalWrite(S3,HIGH);
 // Reading the output frequency
 frequency = pulseIn(sensorOut, LOW);
 // Printing the value on the serial monitor
 Serial.print(",");//printing name
 Serial.println(frequency);//printing RED color frequency
 delay(100);
}
```

3.4 Once the code is uploaded and executed, you can open the Serial Monitor to read readings of the colour in front of the sensor.

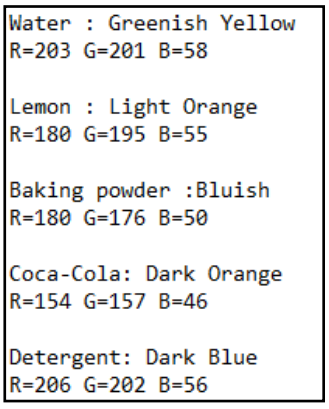


3.5 Test different colours with the colour sensor (by putting different colour paper strips on the glass slide and placing it inside the closed box) and make a note of their RGB values. Label each reading with the name of the colour paper strip that you used to get the reading. Your list of observations might look like this:



[Note: Your readings might differ from the ones mentioned here]

3.6 Now, test the pH levels of different chemicals using litmus paper and put those strips between the glass slides to get their readings on the monitor. Note down the observations in the same format as before. It may look like this:



With this, you have made your own pH monitor and a chart that contains colour values for all different observations.

Stage 4: AI integration with the pH sensor for automatic identification of soil's acidic or basic conditions (Subject Teacher and AI Faculty).

Empathise: Ask learners to answer the following questions:

1. Is the device built-in Stage 1 simple enough for a farmer to use in the field?
2. How can the device be further improved?

Define: Ask learners to ponder upon the possibility of using Artificial Intelligence into making a device that can give direct results based on the nature of the soil and how can the user interface of this device be simplified for everyone to use.

Ideate: Learners further the experiment by adding the element of Artificial Intelligence to their device. Here's how they may do so:

4.1 Navigate to https://machinelearningforkids.co.uk/#!/welcome and click on Get Started.

4.2 Click on Try without registering and then click on Add a new project.

4.3 Give a name to your project and in Recognising, select Numbers.

4.4 Since we are working with 3 values of color (R,G,B), click on add a value button and add Value Name as R and select value type as numbers. Do the same for G and B.

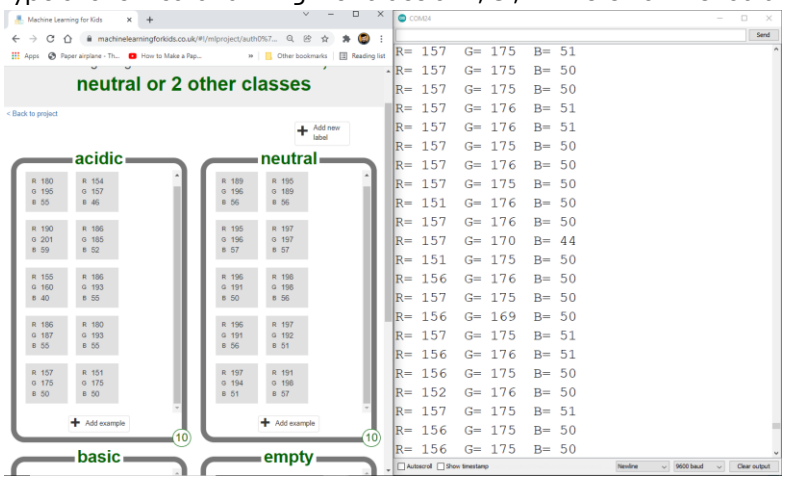
4.5 After adding values, click on Create. This will lead to your first project. Click on it.

4.6 First, to train the model, click on the Train button and then click on Add new Label button.

4.7 Create four labels: Acidic, Basic, Neutral, Blank (for when there is nothing in the box)

4.8 Post creation of labels, click on Add example for each of the labels and add values that fit under that label from the observations you had made

4.9 You may also do this by putting the values appearing on the serial monitor for a particular type of chemical and filling the values of R, G ,B. This is how it should look like:



4.10 Once you have added enough samples to each label, click on Back to Project button and select the Learn and Test option.

4.11 Under this, click on the Train New Machine Learning model.

4.12 Once the training is complete, your model will be able to identify any RGB value as acidic, basic, neutral or blank. Test the model with different values to see if it works properly or not.

Now it's time to integrate the AI model with the device. Here is how we do it:

Step 1: To run your AI model with your device, you will need the API key. For this, click on the Make button and select Python.

Step 2: There, you will find the API key written for your AI model. Note it down and put it in the code where it asks for the API key.

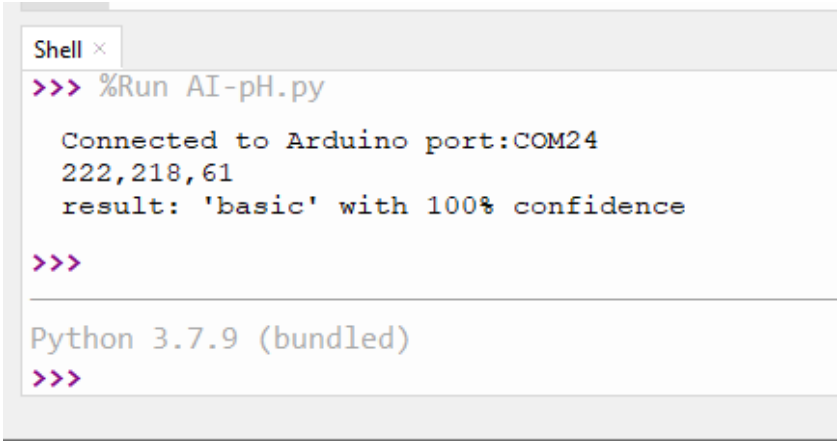
Step 3: Here is the Python code:

```
import requests
import serial

arduino_port = "COM24" #serial port of Arduino, change this to the serial port of your arduino
baud = 9600 #arduino uno runs at 9600 baud
```

```
ser = serial.Serial(arduino_port, baud)
print("Connected to Arduino port:" + arduino_port)

# This function will pass your numbers to the machine learning model
# and return the top result with the highest confidence
def classify(numbers):
  key = "Insert-your-API-key"
  url = "https://machinelearningforkids.co.uk/api/scratch/"+ key + "/classify"

  response = requests.post(url, json={ "data" : numbers })

  if response.ok:
    responseData = response.json()
    topMatch = responseData[0]
    return topMatch
  else:
    response.raise_for_status()

getData=str(ser.readline())
data=getData[2:][:-5]
print(data)
dataSplit=data.split(',')

# CHANGE THIS to something you want your machine learning model to classify
data1 = dataSplit[0]
data2 = dataSplit[1]
data3 = dataSplit[2]

demo = classify([ data1, data2, data3 ])

label = demo["class_name"]
confidence = demo["confidence"]

# CHANGE THIS to do something different with the result
print ("result: '%s' with %d%% confidence" % (label, confidence))
```

Step 4: Copy the code and run it on a python IDE (Consult the AI teacher for any assistance).

Step 5: Once you run the code, the output should look something like this:

	 **Step 6**: Now, you may test the pH of the soil by putting the pH strip of the tested soil in the glass slide. As soon as the strip is put inside the box, the code will display the output as acidic, basic, neutral or blank.
Learning Outcomes	The learners will be able to: • relate soil fertility and acid rain with air pollution. • explain the acidic nature of rain, when combined with oxides of Nitrogen and Sulphur. • write word equation for formation of acid rain. • apply learning of ill-effects of acid rain and coming up with neutralizing its effect, or reducing it. • understand the functioning of a colour sensor, and use it in a meaningful way. • learn about the significance of conditions and how to use them in a program. • combine their knowledge around chemistry, electronics and AI to create their own project. • develop algorithms to use microcontrollers with sensors. • build an AI model to predict whether the soil is acidic, basic or neutral.
Glossary	• **Arduino Uno:** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins. • **TCS3200 Color Sensor**: TCS3200 chip is designed to detect the colour of light incident on it. It has an array of photodiodes (a matrix of 8x8, so a total of 64 sensors) • **Machine learning** is a subfield of artificial intelligence, which is broadly defined as the capability of a machine to imitate intelligent human behaviours. Artificial intelligence systems are used to perform complex tasks in a way that is similar to how humans solve problems. • **Data Acquisition:** Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that are required for the AI model. There can be various ways to collect data. • **Data Exploration:** Data Exploration refers to visualizing the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualize the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. • **Data Modeling:** Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split into a training set and

	a testing set. The model is trained on the training set from which it makes its own rules that help the machine to give an output and the model is then evaluated on the testing set. ● **OpenCV:** OpenCV is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez. The library is cross-platform and free for use. ● **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 ● Algorithmic thinking ● Data gathering ● Model optimization **Design thinking** ● Ideation ● Prototyping **Mathematical and quantitative skills** ● Probability ● Graphical Representation **AI domain** ● AI for Data **Physical computing** ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network **Social impact solution building** ● Problem identifying ● Problem scoping ● Problem solving Prototyping the AI and tinkering solution **Intrapersonal skill** ● Observation skill ● Creative mindset **Interpersonal skill** ● Empathy ● Collaboration **Computational Thinking** C programming (Arduino)

Class 8
Lesson 8.3
Land, Soil, Water, Natural Vegetation and Wildlife: Chapter 2

Parameters	Description	Note for teachers
Chapter Covered	Chapter 2: Land, Soil, Water, Natural Vegetation and Wildlife	
Name of the Book	NCERT, Social Science Textbook for Class VIII	
Learning Objectives	Students will study about land as one of the most significant natural resources, many physical variables that affect how land is used, and the reasons why people move from rural to urban regions in this chapter. Along with learning about soil preservation, students will also study about soil, elements affecting soil profile, and causes of soil degradation. Enhancing the study of plants and fauna beginning in class six also entails. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Understand the land use and conservation of land resources. ● Know about soil, factors of soil formation and conservation measures. ● Identify the problem of water availability, conservation of water availability and its resources. ● Interpret distribution of natural vegetation and wildlife conservation. ● Develop awareness about resource conservation and take initiatives towards the conservation process. ● Analyse the importance of proper use of resources for sustainable development. **AI and Tinkering** **Stage 2 : Apply Design Thinking framework** ● Identify different kinds of soil and ways to modify soil structure to reduce erosion. ● Identify distribution of water bodies and reasons why water should not be wasted. ● Understand the method of its conservation. **Stage 3: Making a hardware** ● Identify the problem of water availability, conservation of water availability and its resources. ● Interpret distribution of natural vegetation and wildlife conservation. ● Understand how to classify healthy and unhealthy plants automatically. **Stage 4: Making AI enabled software** ● Develop awareness about resource conservation and take initiatives towards the conservation process. ● Analyse the importance of proper use of resources for sustainable development. ● Apply the knowledge of Data Acquisition and methods of data collection, and how to label data. **Stage 5: Making complex Modeling** ● Comprehend the image classification and theory behind it. ● Understand AI Modeling and its application.	Teacher can develop a ppt to elaborate different concepts of soil formation, importance of soil conservation, flora and fauna.
Time Required	5 periods of 45 minutes each.	
Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular class room arrangement. ● Activity Sessions – Flexible (for group / pair work).	

Material Required	**Scholastic**: ● Textbook ● Smart Board / screen and projector ● Pen and paper ● White board and marker **AI and Tinkering** ● Webcam ● Personal Computer/Laptop with Internet Connection	
Pre – Preparation Activities	**Scholastic**: ● A brainstorming session about the significance of three most important natural resources: Land, Soil and Water, without which humans cannot exist and how these are important to sustain life on earth. ● Teacher shows pictures to students to elicit information related to different types of natural vegetation and their interconnection with wildlife. **AI and Tinkering:** ● The teacher makes the arrangements for hardware and good Internet connection required to conduct the activity.	students can be ask to make concept chart or mind map of the lesson.
Previous Knowledge	**Scholastic**: ● Students recall the learning of their previous class and describe the factors that influence the distribution and nature of natural vegetation. **AI and Tinkering:** ● Basic understanding of Teachable Machine Platform. https://teachablemachine.withgoogle.com/v1/ ● Image Classification and Processing. ● Basics of Data Collection and Data Evaluation.	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** **Warm-up Activity:** 1. Teacher encourages students to conduct a survey among their family or neighbourhood for people above 50 years of age and ask them how land was used in their young age and how their life has changed over the years. **Introduction to soil, water availability and its conservation :** 2. Teacher shows samples of different kinds of soil to students to make them understand about their similarities and differences. 3. The teacher shows a video to make the learners recapitulate and understand the formation of soil and its layers. Video: Formation of soil and its layers https://youtu.be/vqtdFaclWf0	

	4. The teacher further shows another video to show water availability and its conservation. Video: To show water availability and its conservation https://youtu.be/NS6SQ6vcJFk **Introduction to Natural Vegetation:** 5. Teacher brings all students to the school kitchen garden to make them understand about natural vegetation. **Tree Plantation Activity:** The teacher organizes a Tree Plantation drive in the school and explains how the well-being of nature is essential to the well-being of humans. 6. to make the students understand the importance of Van Mahotsav and its relevance in their lives. 7. to realize the necessity of forests in our lives and the need for conservation of wildlife. **Following videos can be used for reference** ● https://youtu.be/66Qsy7fTT_k ● https://youtu.be/UNWYm3-Mz04 **Contextualization**: **AI and Tinkering** **Stage 2 - Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher & ATL In-charge)** **Problem Statement /Scenario:** *While playing in the park, Vishal observes that some plants are not healthy. They seem to have either dried or turned yellowish in colour or their leaves appear to be damaged.* **Empathize**: Students are asked to brainstorm on the above scenario and they are made to think deeper about it by asking the following questions: 1. What they feel when plants leaves turn yellow, damaged or dried? 2. How do you think this represents that that health of the plants is not good? **Define:** To delve deeper the students are asked the following questions: 1. Do you also witness such situations? 2. Wouldn't it be good if you can help in saving these plants from dying? 3. Would you want to think deep and solve this problem? 4. Can you think together to help solve these problems of monitoring the health of plants? 5. What solutions can you think about to check if the plants were suffering from some disease. (hint a device can be made) **Ideate:** Learners are now asked to come up with different alternatives to resolve the issue of vegetation conservation and also how monitoring of plant health could be done. **Stage 3 : Data Collection for plant disease detection (Subject Teacher and ATL in-charge).**

In this activity, the learners will learn about the plant disease detection and data collection process for the same through data acquisition using the Online method of data collection (using available websites and databases). The data collected for plant disease will be further used to train the model for making predictions for plant disease.

3.1 Teacher helps students understand various types of plant disease and ways to identify them. (The learners will have an understanding of the type of data they should look for to do the disease prediction.)

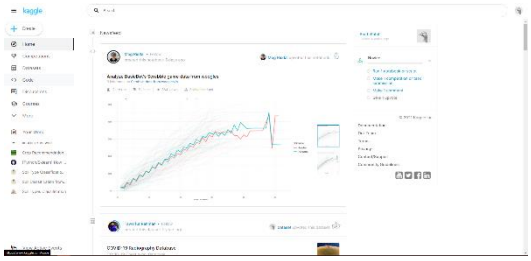
- Possible QA.
- What are plant diseases?
- How to identify them?

- After understanding the students will search for databases available online.
  - Possible QA :-
  - What are the websites available for finding datasets?
  - What databases are open-sourced and readily available?
- Once the database is found, the students will evaluate the database and clean the dataset to make better and accurate predictions (i.e. remove unnecessary images/data points)
- Alternatively the ATL in-charge can also suggest students to go to their playground to collect 5 to 10 samples of leaf image and add it to their dataset.

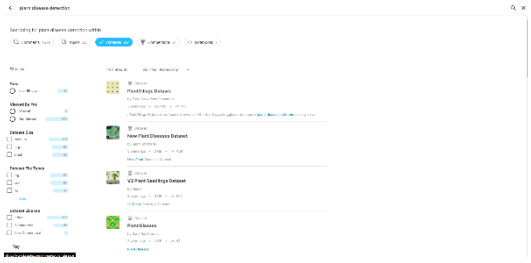
3.2 Activity to collect data using Kaggle website:

Following is a step by step process to follow the activity to collect the data using kaggle website:

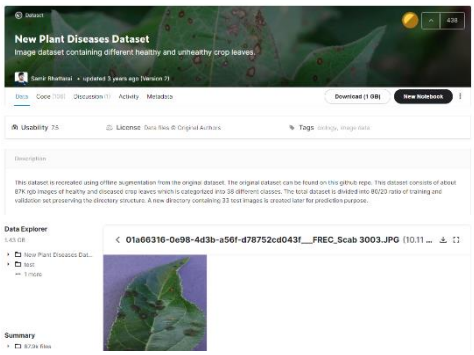
- Open a browser and open the website www.kaggle.com
- After opening the website, create an account on the website. This is how the home page will look after logging in.



- Since the task is to search for plant disease dataset, the learners will make a query of plant disease detection dataset in search bar.



- Select the appropriate dataset and start downloading the dataset.



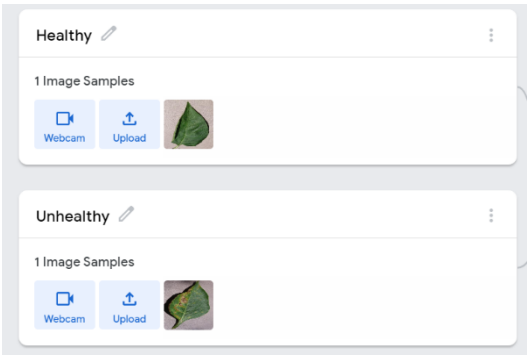
3.3 After collecting the dataset it is cleaned for further processing, wherein the learners can remove the unwanted images or wrong images from the dataset.

Stage 4: Disease Prediction using teachable machine (AI)(Subject teacher and AI Faculty)

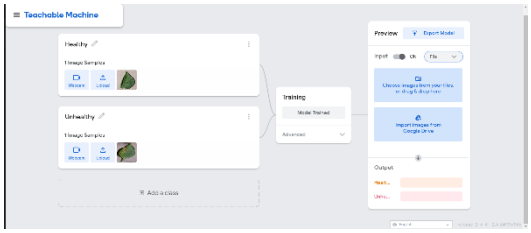
4.1 Data Collection : The students will collect data as mentioned in images given below. For each type of data to be collected, they will upload them to their respective classes, and upload as many images as possible to build an accurate model.

Two classes are added:

- Healthy Plant
- Unhealthy Plant

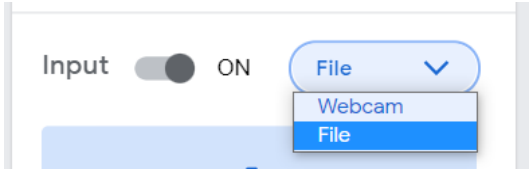


4.2 Data Processing and understanding the Use Case : The students clicking on 'Training the Model'. Teachable machine model's Artificial Intelligence begins with this step and the processing starts using the data uploaded

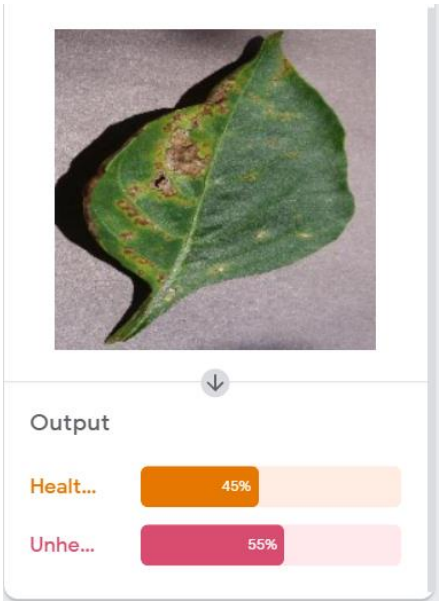


4.3 Data Transfer and Modeling : After the model is trained, it is tested.

The learner clicks on the top right button and changes the mode to File form Webcam (as shown below).



The next step is to test the model by uploading the image for plant health analysis.

	 As per the given output, it shows the plant as unhealthy with 55% probability. The probabilities can change according to the database size and quality. The output probability also suggests the confidence of the model in prediction. The learners need to take care of the following parameters, if the output is not accurate. ● Add good quantity of data. ● Ensure there are no errors in data. ● Ensure the classes are labelled properly.
Learning Outcomes	The learners will be able to: ● plan and conduct investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own. ● relate processes and phenomena with causes and effects, apply scientific concepts in daily life and solve problems. ● communicate the findings and conclusions effectively. ● apply learning to real life situations.
Glossary	● **Data Acquisition**: Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that is required for the AI model. There can be various ways to collect data. ● **Data Exploration**: Data Exploration refers to visualizing the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualize the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. ● **Data Visualization**: Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split into training sets and testing sets. The model is trained on the training set from which it

	makes its own rules that helps the machine to give an output and the model is then evaluated on the testing set.
Skill outcomes	**Tech skill** ● Digital learning ● Algorithmic thinking ● Data gathering ● Model optimization **Design thinking** ● Ideation ● Prototyping **Mathematical and quantitative skills** ● Probability ● Statistical Analysis ● Graphical Representation **AI domain** ● AI for Data **Physical computing** ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network **Social impact solution building** ● Problem identifying ● Problem scoping ● Problem solving Prototyping the AI and tinkering solution **Intrapersonal skill** ● Observation skill ● Creative mindset **Interpersonal skill** ● Empathy ● Collaboration **Computational Thinking** ● C programming (Arduino)

Class 8
Lesson 8.4
Industries - Chapter 5

Parameters	Description	Note for teachers
Chapter Covered	Chapter 5: Industries	
Name of the Book	Resources and development: Geography NCERT, Textbook for Class VIII	
Learning Objectives`	Students will study the secondary sector of the economy in this session, particularly the industries that deal with the extraction of resources, the production of goods, or the delivery of services. Additionally, students will be able to comprehend why urban Expansion and growth are frequently caused by industrialization (urbanisation). Industries are divided into different categories according to their size, ownership, and raw material requirements. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Understand the term 'Industries' as a secondary economic activity. ● Classify the industries based on raw material, size and ownership. ● Enlist the factors which influence the location of industries. ● Distribution of major industries in India in different geographical regions. **AI and Tinkering:** **Stage 2 : Apply Design Thinking framework** ● Understand the term 'Industries' as a secondary economic activity. ● Classify the industries based on raw material, size and ownership. ● Understand applicability of the concepts of production cycle and build solution to improve and increase the production quantity. **Stage 3: Making a hardware** ● Understand how IR sensor works as a counter. ● Build an AI model to predict accuracy of the sensor. **Stage 4: Making AI enabled software** ● Develop algorithms to use microcontrollers with object counting. **Stage 5: Making complex Modeling** ● Combine their knowledge around sensor technology with electronics and AI to create their own project.	The teacher can develop a ppt or concept map to elaborate the topic.
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	**Scholastic:** ● Textbook ● Smart Board / screen and projector ● Pen and paper ● Laptop or smartphone ● White board and marker **AI and Tinkering:** ● IR sensor ● Arduino Uno	
Pre – Preparation Activities	**AI and Tinkering:** ● Check the availability of hardware components. ● Availability of a system with good internet connection and data collected.	
Previous Knowledge	**Scholastic:** The students know about: ● different types of industries. ● different sectors of economy. **AI and Tinkering:** The students know basic knowledge of the following, in order to make the prototype. ● Programming an Arduino UNO Board. ● Sensor connections and usage. ● Basics of Regression and AI Modeling. https://www.socscistatistics.com/tests/regression/default.aspx	students can be asked to make a comic strip/ poster on different kinds of industries on the basis of ownership, raw material used or any other factor.
Methodology	**Stage 1: Conceptualization: Scholastic: (Social Science Teacher)** The teacher leads the learners into the understanding of industries : **Activity 1: Flow Chart** ○ The learners draw a flowchart to understand the classification of industries based on raw material, size and ownership. **Activity 2: Map Work** ○ The learners mark on map distribution of major industries in India in different geographical areas: State wise or region wise. ○ Teacher initiates a whole class discussion to identify various factors affecting choice of industrial location. **AI and Tinkering:**	

Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher)

Problem Statement / Scenario: *The school organised students' visit to Surajkund International Crafts Mela in Faridabad. There was a lot of excitement among students as they moved from stall to stall at the fair. They were surprised to see a huge variety of products from India and many other countries. Aditi and Kushal wondered at the bulk material brought to the venue by different participating states of India and other countries. They were curious to know how vendors estimated the amount of raw material and finished goods they would need to meet the demand of the customers at the event.*

Empathize: During the post-visit feedback session, students discussed their thoughts with their teacher and classmates reflecting upon the problem of surplus or shortage of products during a sale at the event. Students are asked to brainstorm on the above scenario and they are made to think deeper about it by asking the following questions

1. What all products do you think was there at the fair?
2. Can you think about how vendors estimated the amount of raw material and finished goods they would need to meet the demand of the customers at the event?
3. What do you think about the concern of production and sales forecasts of manufacturing industries for the products?

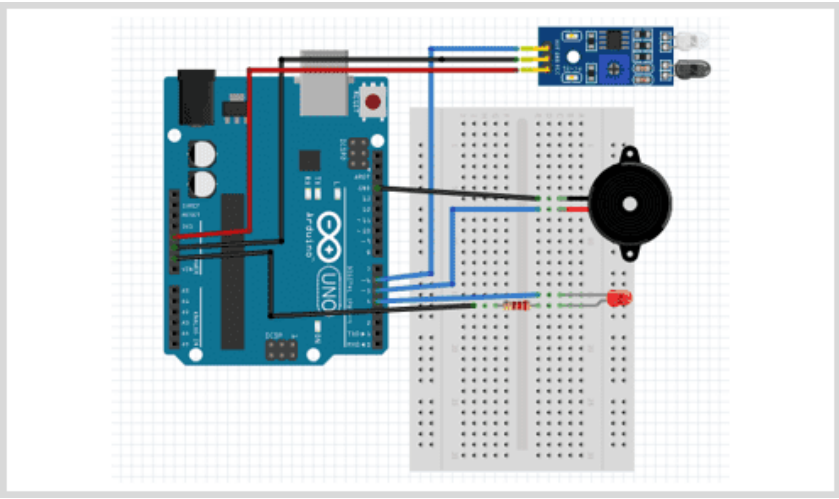
Define: To delve deeper the students are asked the following questions

1. Have you also noticed and reflected on situations where the demand needs to be predicted based on how much material or product would be required?
2. There might occur a situation when the product is less or surplus. Can you think of some solution to solve this problem?

Ideate: Students are now asked to think and forecast about ways and solutions to check the quantity of product to be produced, keeping in mind the expected sales.

Stage -3 IR sensor-based production counter -Tinkering: (Subject teacher and ATL in-charge)

3.1 Making the Hardware: In this the students will learn to count objects using IR sensors and use the produced count to emphasize on the production capacity. Following schematics will be referred to, to connect the hardware:



3.2 Algorithm : After connecting the hardware according to the schematic, the learners make an algorithm on which the programming will be based. Following steps to be followed to understand the key steps and their structure:

Step 1. Data Collection : In order to understand, the learners will need to count the number of objects.

- Define the Pins through which data is collected from Arduino UNO
- Take Input from Analog pH sensor
- Store the values in variables

Step 2: Data Processing: The data collected is in the raw stage and needs to be processed for further understanding and analysis.

Step 3: Data Transfer : Once the data is processed, it is transferred to the system through serial communication using USB Cable.

- Send the processed data from Arduino to the system
- Store all the processed data to be transferred in a String
- Send the data using Serial Communication every time an object is counted.

```
#define led 4          // led at pin 4
#define buzzer 5       // buzzer at pin 5
#define sensor 6       // ir sensor at pin 6
int sound=250;         // set buzzer sound
 int count=0;
 boolean state = true;
void setup()
{
Serial.begin(9600);
pinMode(sensor,INPUT);
pinMode(led,OUTPUT);
pinMode(buzzer,OUTPUT);
}


void loop()
{
int detect=digitalRead(sensor);   // read status of sensor
if(detect==HIGH)             // if sensor detects obstacle
{
digitalWrite(led,HIGH);        // led on
tone(buzzer,sound);          // buzzer sounds
```

```
count++;
}
else{
digitalWrite(led,LOW);
noTone(buzzer);
}
delay(300);
}
```

Stage 4 : Making the software to count data (Subject teacher with AI faculty)

4.1 Importing data from Hardware : In the previous section, a hardware prototype was made using the following components:

- IR sensor - to detect the object
- Arduino Uno - to collect data from the sensors and make count

Once the hardware is set up, data is collected from the sensors at regular intervals.

Now the data collected from the sensor will be used as follows:

- The data is captured from the serial monitor and stored in a csv (comma separated values) file for further usage.
- The students note down the values in the csv by measuring from Arduino.

4.2 Data Exploration

- After introduction to the hardware of the IR sensor and the production object, the next step is to create a model which can predict the accuracy based on the above parameters.
- In order to achieve this, there is a need to create a labelled dataset that can be used to train the model for classifying the accuracy of object detection as per the analog data.
- This can be done by deliberately using different instances of the object:
  - Option 1: Place the object before the sensor.
  - Option 2: Remove the object before the sensor.

- The data captured after following either of the above-mentioned steps needs to be labelled as per the labels: Present or Absent. The presence of the object will be counted as a +1 to the total count and the absence will be counted as empty space (+0).

An example of the data is given below.

Day production	IR data count
Day-1	11
Day-2	13

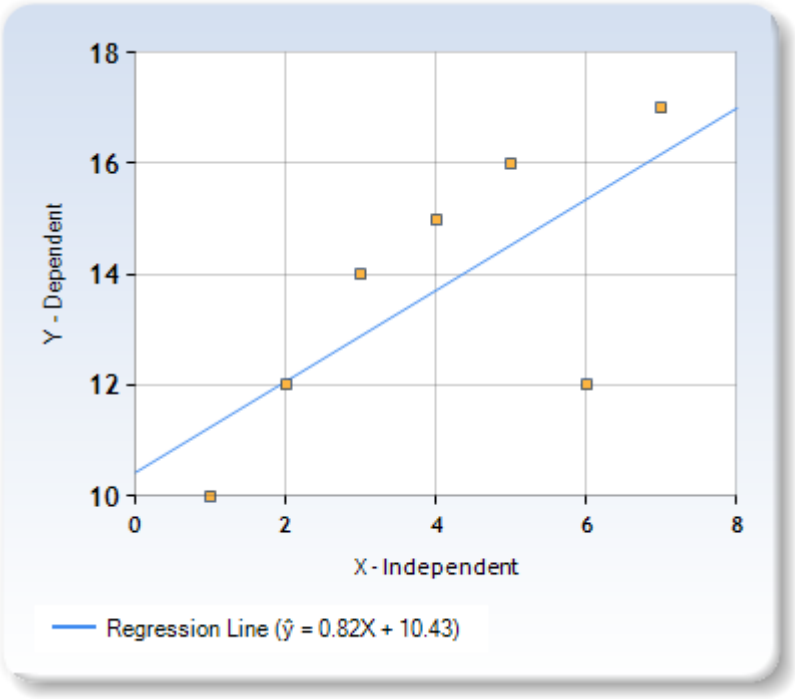
The production count data then will be used for the AI Modeling and prediction of the production quantity.

Steps 5 – Develop a model for predicting production quantity (Subject teacher and AI faculty)

- The previous stage started with counting the production orders in-order to understand the production capacity.
- To take this forward, the next step is to try complex Modeling techniques on the same data set and compare the performance of both the models.
- This simple linear regression calculator uses the least squares method to find the line of best fit for a set of paired data, allowing the learners to estimate the value of a dependent variable (Y) from a given independent variable (X).
- For example, if a line of best fit is generated for the association between height and shoe size, allowing the learners to predict shoe size on the basis of a person's height, then height would be the independent variable and shoe size the dependent variable.
- Hence, data is needed to predict the production quantity in the future. For that the learners will need to run a Linear regression model that will be run on the dataset of the counter.

5.1 Data is put into two different columns. Column-X corresponds to Production time, while Column-Y has the Production quantity data.

5.2 The plot of data as given below is generated.



The above image shows the relation between the production quantity with relation to Production time. With the relative graph, future production quantity can be predicted using a relative dataset.

External Link: https://www.socscistatistics.com/tests/regression/default.aspx

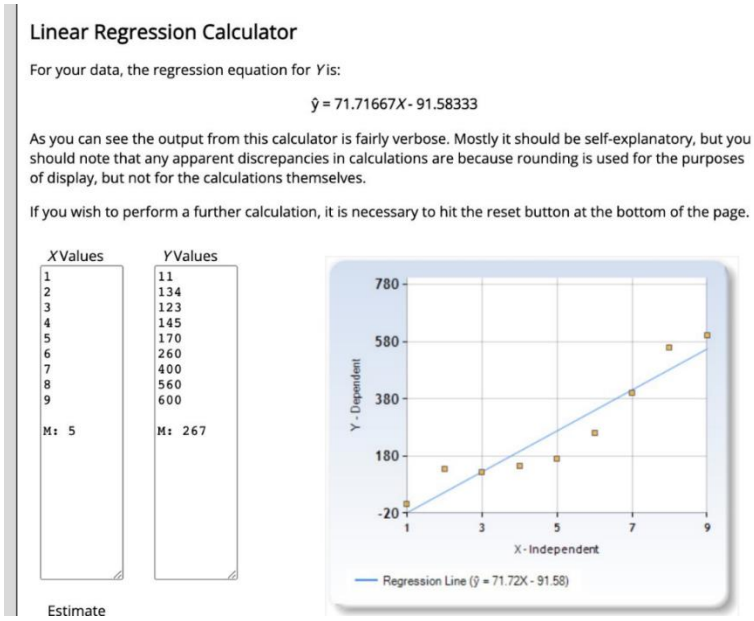


Image-1 (above): shows the X - Y values of the production time and Production quantity, accordingly and shows an image with a plot of the same for the Linear regression method.

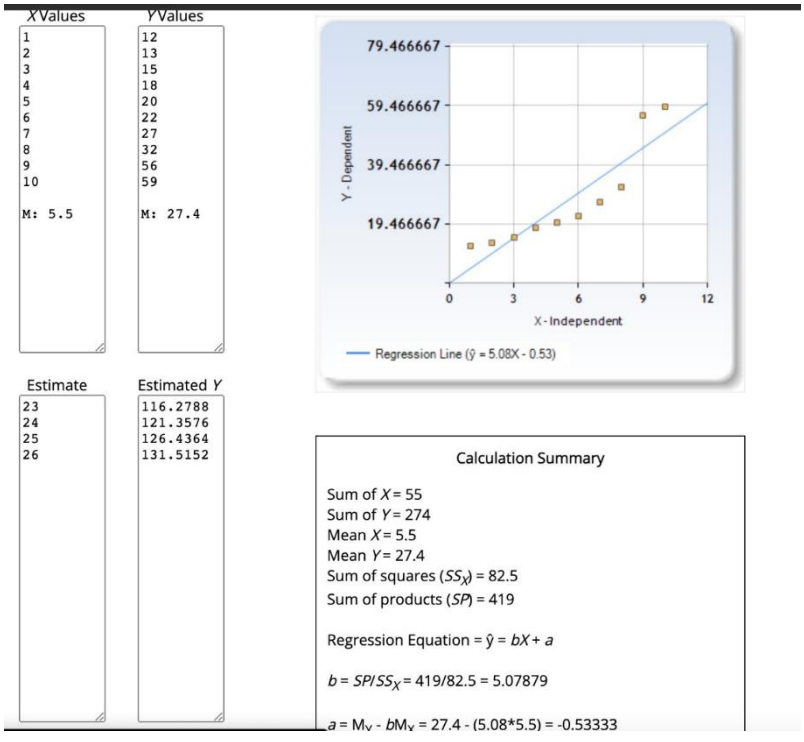


Image-2: shows the prediction of the production quantity using the estimate function shown in the above table.

Hence, for the relative estimate of 23rd day - Estimated production quantity is 116.

The learners can find a similar estimation using the above tutorial.

Code Snippets(1): (only for understanding and reference)

```
def Lin_Reg(x, a, b):
```

	y = (a*x)+b return y **Code Snippets(2): (only for understanding and reference)** while True: x = int(input("Enter the value of estimated days")) a = int(input("Enter the 'a' variable ")) b = int(input("Enter the 'b' variable")) print(Lin_Reg(x, a, b)) **Observation:** ● After the model is trained in the above step, the prediction of production quantity is received using the Linear Regression model. ● The learner observes the difference in the performance of both models. The next step is to try and check the performance of the model by increasing the amount of data.
Learning Outcomes	The learners will be able to ● understand the term 'Industries' as a secondary economic activity. ● classify the industries on the basis of raw material, size and ownership. ● enlist the factors which influence the location of the industries. ● distribution of major industries in India in different geographical locations ● describe Industrial Disaster and analyze the factors responsible for such disaster. ● plan and conduct investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own. ● relate processes and phenomena with causes and effects, apply scientific concepts in daily life and solve problems. ● apply learning to hypothetical situations.
Glossary	● **IR Sensor:** An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment ● **Buzzer:** A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). ● **Digital Signals:** A digital signal, on the other hand, has only two values: HIGH and LOW. ● The **line of best fit is** described by the equation $\hat{y} = bX + a$, where b is the slope of the line and a is the intercept (i.e., the value of Y when X = 0). This calculator will determine the values of b and a for a set of data comprising two variables and estimate the value of Y for any specified value of X. ● **Linear Regression:** Regression is a statistical method used in finance, investing, and other disciplines that attempt to determine the strength and character of the relationship between one dependent variable (usually denoted by Y) and a series of other variables (known as independent variables). ● **Analog pH sensor:** is a sensor designed to measure the pH of the solution and reflect the acidity or alkalinity.

	• **The least squares method:** is a statistical procedure to find the best fit for a set of data points by minimizing the sum of the offsets or residuals of points from the plotted curve. • **Data Acquisition:** Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that are required for the AI model. There can be various ways to collect data. • **Data Exploration:** Data Exploration refers to visualizing the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualize the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. • **Data Modeling:** Data Modeling is a process used to define and analyze data requirements needed to support the business processes within the scope of corresponding information systems in organizations.
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern Recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability • Statistical Analysis • Graphical Representation **AI domain** • AI for Data **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Persuasion • Creative mindset **Interpersonal skill** • Empathy • Collaboration **Computational Thinking** • C programming (Arduino)

Class 9
Lesson 9.1
Why do we fall ill? - Chapter 13

Parameters	Description	Note for teachers
Chapter Covered	Chapter 13: Why do we fall ill?	This Lesson Plan must be taken after teaching the 'Section: 13.3.2 Means of Spread from Chapter 13: Why do we fall ill? NCERT, Science Textbook of Class IX
Name of the Book	NCERT, Science Textbook for Class IX	
Learning Objectives	This chapter aims at informing the learners about disease transmission, their routes and relevant preventive measures. In this lesson plan, learners will work toward timely identification of food spoilage. It will also help them ponder on the role of oral-faecal route in disease transmission. To enable learners to: **Scholastic:** **Stage 1: Conceptualization** ● Understand the various routes/means of disease transmission. ● Study the spread of polio via the oral-faecal route. ● Identify the causative behind foodborne diseases. **AI & Tinkering:** **Stage 2 : Contextualization by applying Design Thinking framework** ● **Identify the problem in the given scenario** ● Come up with possible reasons that can result in food spoilage and how to detect whether the food is spoilt ● Ideate on how and which sensors can **act as an alternative to the humans' sensory organs such as nose** ● Understand how to track food spoilage by using sensors. **Stage 3: Prototype to make an electric nose** ● Connect gas sensors to arduino board ● Write code to collect data into csv files from the serial monitor ● Train a machine learning model using numeric data. ● Observe the reading and analyse the readings from the sensors under different conditions **Stage 4: Automatic food hygiene checks** ● Come up ideas to develop an automatic and intelligent food spoilage detection device.	
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 ● Whiteboard and marker ● Computer (1 for a group of 5) ● Arduino UNO ● Arduino Adapter ● Arduino connector ● 5V DC power supply ● MQ3 Gas sensor ● Jumper Wires ● Python IDE ● Python Package: Pandas & Scikit-learn	
Pre – Preparation Activities	**Keep the following links ready:** ● **WHO: Vaccine-derived polio viruses**? https://www.youtube.com/watch?v=CZxqz4bX048&ab_channel=WorldHealthOrganization%28WHO%29 ● **Communicable diseases** https://www.youtube.com/watch?v=LBkXQ_mBO3Q&ab_channel=NationalInstituteforCommunicableDiseases ● **Cross Contamination and Food Safety.** https://www.youtube.com/watch?v=gzsV-neH3SI&ab_channel=LitmosHeroes ***Teachers can use mind mapping/system mapping tools such as coggle or loopy to demonstrate multiple ways in which the food is spoilt*** **Facilitators may go through the following videos for more information:** ● Polio Vaccination drive in India. https://www.youtube.com/watch?v=q084duwxo74&ab_channel=UNICEF	
Previous Knowledge	**Scholastic:** The learner understands the concept of: ● Food infection **AI and Tinkering:** ● Basic knowledge of sensors and their purpose. ● Using electronic components to form basic circuits by connecting in different ways. ● Basic concepts of Python programming – how to write a code and execute it.	

Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** ● Teacher discusses a case study on Polio and further asks learners the following questions: ➢ Have you seen any Polio infected person in your life? ➢ If yes, what was their financial condition? ➢ Why do you think polio is not present in big cities? (Hint: Better sanitation and hygiene practices) ● The learners will figure out other ways by which polio transmits after watching this video - WHO: Vaccine-derived polio viruses. https://www.youtube.com/watch?v=CZxqz4bX048&ab_channel=WorldHealthOrganization%28WHO%29 ● Post discussion, facilitator shows a video on communicable diseases.https://www.youtube.com/watch?v=LBkXQ_mBO3Q&ab_channel=NationalInstituteforCommunicableDiseases ● The facilitator will now ask the learners the following questions: ➢ Has anyone ever had food poisoning? ➢ Nausea? Upset stomach? ➢ What led to the illness? ● To conclude, facilitator shows a video on Cross Contamination. https://www.youtube.com/watch?v=gzsV-neH3SI&ab_channel=LitmosHeroes Discussion on things / habits that cause food spoilage and the names of most common food spoilage pathogens. **Contextualization**: **AI and Tinkering**: **Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario and integrate gas sensors as an electronic nose to detect spoiled food (Subject Teacher & ATL in-charge)** **Problem Statement / Scenario:** *Prabhu is a chef and runs a restaurant in New Jersey. One day, he was visited by two of his clients. They both complained of food poisoning 5 days later. According to them, their symptoms appeared after having dined at Prabhu's restaurant. Fortunately, they didn't take any actions against Prabhu due to his good behavior. However, Prabhu was a little worried, thinking of a worst-case scenario, where such complaints would have cost him his restaurant.* The facilitator will now apply the design thinking framework to Prabhu's scenario. **Empathize:** The students will now reflect on the scenario: 1. Why did Prabhu open up an Indian restaurant in New Jersey? 2. What complaints did Prabhu receive from two of his clients? 3. Why was Prabhu worried? (Hint: legal proceedings and food laws are very strict in developed countries, and legal fees are very high, it might cost him his livelihood) 4. What are the possible routes by which food at Prabhu's restaurant could have gotten contaminated? 5. Can food-contaminating microbes be eradicated from the earth? 6. If food spoilage cannot be stopped, can it be detected before it reaches the customer? 7. How do we (humans) identify whether the food is contaminated or not? 8. Which one of our senses plays the most important role in detecting food spoilage?

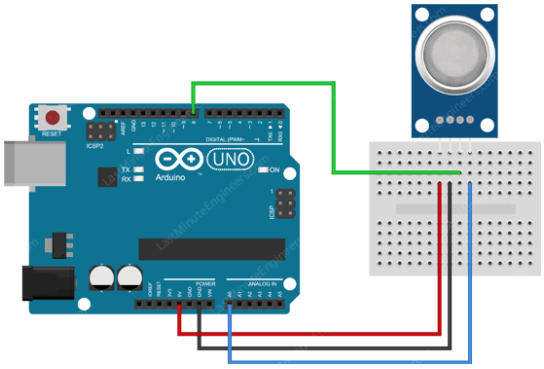
Students then manoeuvre the discussion towards food contamination being the major problem in the entire scenario.

Define: Ask learners to identify factors that may have led to food spoilage in this scenario and to think of possible solutions to detect food spoilage.

Ideate: Ask learners to create a mind map to trace all the possible routes that can result in food spoilage. Learners may come up with various solutions to detect food spoilage. One of which is our nose by which we can smell and detect whether the food is spoiled.
Ask learners to think of various ways in which they can make an electric nose.
Teacher can suggest students to come up with another solution/model

Stage 3: Prototype to make an electric nose (Subject teacher and ATL In-charge)

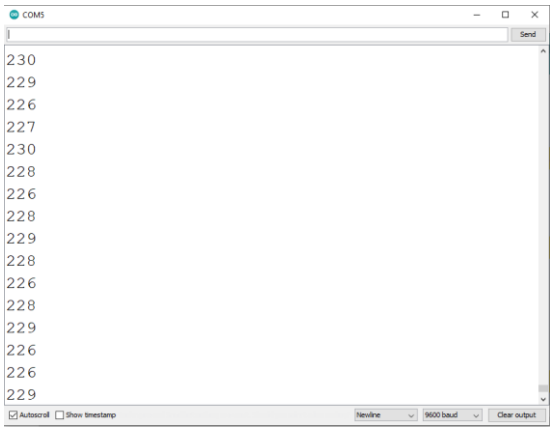
3.1 Connect the MQ3 Gas sensor with Arduino UNO using the following schematics



3.2 Upload the code below in the Arduino UNO and get readings on the Serial Monitor.

```
void setup() {
 // initialize serial communication at 9600 bits per second:
 Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
 // read the input on analog pin 0:
 int sensorValue = analogRead(A0);
 // print out the value you read:
 Serial.println(sensorValue);
 delay(1);      // delay in between reads for stability
}
```

3.3 Sensor's output can be seen in the form of values between 0 and 1023:



3.4 Check the readings for the following states of the sensor:

a. No food near sensor
b. Food present near sensor
c. Spoilt food near sensor

Learners may see a noticeable difference in readings for each of these states. Ask learners to wait for the readings of the gas sensor to stabilize post which they should make an observation table entailing the change in values observed due to the above-mentioned conditions.

Stage 4: Automatic food hygiene checks (Subject Teacher & AI in-charge).

Empathize:

1. Is it possible that some clients may have falsely claimed to have contracted food poisoning, in order to make some money from 'out of court settlement'?
2. In case Prabhu got accused of serving contaminated food, is there any way Prabhu could prove his innocence?
3. Will it benefit: Can Prabhu come up with a well-documented database, that automatically records the hygiene status of the food that is being served.

Define: Ask learners to think of ways in which food hygiene checks could be regulated and automated.

Ideate: Ask learners to come up with a solution to develop an automatic and intelligent food spoilage detection device.

Creating the Device

4.1 First, save the data incoming from the gas sensor in a CSV file with the following Python code:

```
import serial

arduino_port = "COM5" #serial port of Arduino
baud = 9600 #arduino uno runs at 9600 baud
fileName="sensor-data.csv" #name of the CSV file generated
ser = serial.Serial(arduino_port, baud)
print("Connected to Arduino port:" + arduino_port)
file = open(fileName, "a")
print("Created file")
samples = 10 #how many samples to collect
print_labels = False
```

```
line = 0 #start at 0 because our header is 0 (not real data)
while line <= samples:
  # incoming = ser.read(9999)
  # if len(incoming) > 0:
  if print_labels:
    if line==0:
      print("Printing Column Headers")
    else:
      print("Line " + str(line) + ": writing...")
  getData=str(ser.readline())
  data=getData[2:][:3]
  data=data.strip("\n")
  print(data)

  file = open(fileName, "a")
  file.write(data + "\n") #write data with a newline
  line = line+1

print("Data collection complete!")
file.close()
```

4.2 Now we write a separate code to organise the incoming data in an understandable format with the help of the Pandas Library. Name the file as analysis.py

```
import pandas as pd

#reading csv file
data=pd.read_csv('sensor-data.csv')

#shape of dataset
print("Shape", data.shape)

#column names
print("\nFeatures: ", data.columns)

#storing the feature matrix (x) and response matrix (y)
x=data[data.columns[:-1]]
y=data[data.columns[-1]]

#printing first 5 rows of feature matrix
print("\nFeature Matrix:\n",x.head())

#printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

4.3 Open up the csv file that was created with the previous code, and add a column titled "label", and add some labels based on whether the food is absent, present, or spoiled. (Note: The readings might differ for each case)

Sensor Data	Label
893	0
876	0
500	1
450	1
520	1
300	2
340	2
290	2

Here: 0 = No food | 1 = Food present | 2 = Spoiled food

Please note that these readings could be different for you and different for the foods that you test with.

4.4 : After manually labelling the data, we create a model that can predict the state of the food based on the readings from the gas sensor. From the SciKitLearn package, we use the K-Nearest Neighbour classifier model.

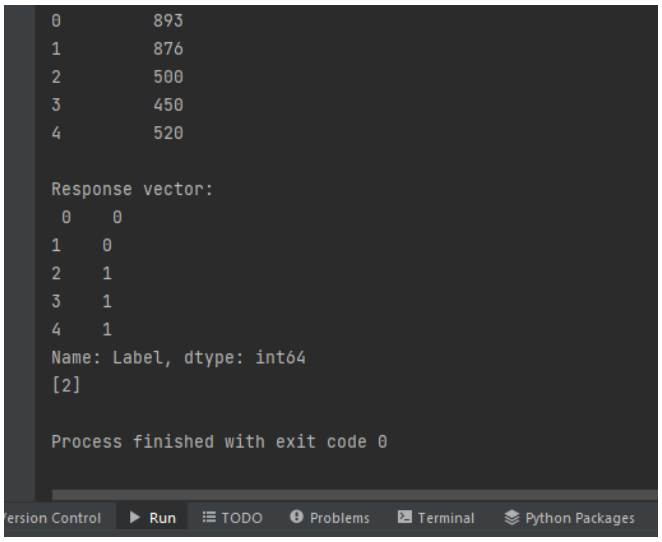
```
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(x,y)
```

4.5: Post execution of the code above, test the model by executing the code below and putting different types of food (healthy and contaminated) in front of the sensor.

```
predicted = knn.predict([[1,25]]) #manually input the values
from arduino in the arguments of the knn.predict()
print(predicted)
```

This is what the whole code looks like when it is put together

```
import pandas as pd
from sklearn.neighbors import KNeighborsClassifier

#reading csv file
data=pd.read_csv('current.csv')

#shape of dataset
print('Shape',data.shape)

#column names
print('\nFeatures: ', data.columns)

#storing the feature matrix (x) and response matrix (y)
x=data[data.columns[:-1]]
```

	`` y=data[data.columns[-1]] #printing first 5 rows of feature matrix print('\nFeature Matrix:\n',x.head()) #printing first 5 values of response vector print('\nResponse vector:\n', y.head()) knn = KNeighborsClassifier(n_neighbors=3) knn.fit(x,y) predicted= knn.predict([[300]]) print(predicted) ``` And this is the output of the code for a sensor value of 300:  ``` 0 893 1 876 2 500 3 450 4 520 Response vector: 0 0 1 0 2 1 3 1 4 1 Name: Label, dtype: int64 [2] Process finished with exit code 0 ersion Control Run TODO Problems Terminal Python Packages ``` As it can be observed, the program returns a 2, which means that your device is ready to help you detect the spoiled food
Learning Outcomes	The learners will be able to ● Apply learning to hypothetical situations, such as maintaining distances in case a friend is suffering from a communicable disease ● apply scientific concepts of food contamination and avoiding foodborne illness transmission ● exhibit values of respect for life ● understand the process of food ripening ● learn hardware integration ● understand data collection and data labelling process ● learn Arduino programming and integration ● understand the Gas Sensor and theory behind it ● understanding AI Modeling and its application
Glossary	● **Data Visualization** :Data Visualization is the process of exploring the data collected through graphs. It also includes the process of cleaning the data to make it ready to be used for training a model. In order to do so in Python, we use the packages pandas and matplotlib.

	• **Pandas:** Pandas is an open-source Python package that is most widely used for data science/data analysis and machine learning tasks. • **Modeling** :Modeling is the process of training the model on the available dataset in order to get a prediction when provided with an input. • The gas Sensor(MQ3) module can be used for gas leakage detection (in home and industry). It is suitable for detecting Alcohol, Benzine, CH4, Hexane, LPG, CO. • **Arduino UNO** :Arduino UNO is a microcontroller with 14 digital and 6 analog input/output pins • **SKLearn Package**: scikit-learn is an open source Machine Learning Python package that offers functionality supporting supervised and unsupervised learning. • **Pandas:** Pandas is an open-source Python package that is most widely used for data science/ data analysis and machine learning tasks. • **CSV**: A comma-separated values (CSV) file is a delimited text file that uses a comma to separate values. Each line of the file is a data record. Each record consists of one or more fields, separated by commas. • **Serial Monitor** : Serial Monitor allows you to both send messages from your computer to an Arduino board (over USB) and also to receive messages from the Arduino.
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern Recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability **AI domain** • AI for Data **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Persuasion • Creative mindset **Interpersonal skill** • Empathy • Collaboration **Computational Thinking** • C programming (Arduino)

Class 9
Lesson 9.2
Improvement in Food Resources- Chapter 15

Parameters	Description	Note for teachers
Chapter Covered	Chapter 15: Improvement in Food Resources	This Lesson Plan can be taken up after teaching them about Rabi and Kharif crops, from Chapter 15
Name of the Book	NCERT, Science Textbook for Class IX	
Learning Objectives	Indian economy is based on agriculture, and with increasing population, the demand for agricultural commodities is increasing day by day. This lesson plan will help the learners think from a perspective of an amateur or new farmer, about all the pre-requisite agricultural practices necessary to implement before sowing the crop and to ensure high productive yield To enable learners to: **Scholastic:** **Stage 1: Conceptualization** ● Identify different crops grown depending on the season. ● Access the prerequisites before sowing a crop. ● Differentiate between Rabi, Kharif and Zaid season crops. ● Understand the relevance of environmental conditions in farming. **AI + Tinkering:** **Stage 2 : Contextualization by applying Design Thinking framework** ● Identifying the problem in the given scenario ● Ideate on finding solutions to segregate various crop based on cropping seasons to identify crops with high yield (cash crops) to earn maximum profit and develop an automatic crop identification system **Stage 3: Prototype to develop an AI model for identifying crops** ● Understand how to develop an AI-enabled image classification model. ● Learn how to create mobile applications using Scratch. ● Brainstorm and ideate ways to use technology for better farming. **Stage 4: Developing Farmer's App for automatic identification and generating information about the crop of interest** ● Come up with ideas to develop a mobile application that helps farmers stay up to date with crop-related information automatically using App Inventor.	
Time Required	5 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 ● Whiteboard & Marker ● Computers with Webcam ● Good internet connectivity ● Smartphone	
Pre – Preparation Activities	**Teacher to keep the following resources ready before the session**: How cropping patterns increase the farm yield ● https://www.youtube.com/watch?v=FAjlxWtQ19Y&ab_channel=CBSE	
Previous Knowledge	**Scholastic:** The learner understands the concept of: ● Agricultural practices (grade 8). ● Cropping seasons (Rabi and Kharif). ● Season based sown crops.	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** 1. Ask learners to list the natural phenomena or physical quantities (external stimuli) like rainfall, sunlight, humidity, etc. that directly affect the plant growth. 2. Now, ask them to highlight the weather phenomena that affect the plant growth out of their list. 3. Ask learners to list down the reasons behind farmers adhering to cropping seasons when growing crops. (Hint: To enhance crop yield, which means more cash flow) 4. Explain the various cropping patterns that farmers use to enhance their farm yield with this video: https://www.youtube.com/watch?v=FAjlxWtQ19Y&ab_channel=CBSE ***Teachers can use PowerPoint presentations to create graphs that plots the various types of crops against its profits*** **Contextualization**: **Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario Segregation of various crops based on cropping seasons (Subject Teacher & ATL in-charge).** **Problem Statement / Scenario:** *Deen Dayal was a middle-aged wealthy farmer living with his joint family in his ancestral mansion. He owned huge farmlands in Satara district. After his untimely death, his eldest son Ameya had to quit his job as an investment banker and relocate to Satara to take care of the family business. His family had always been a mass producer of Rabi Jowar and Kharif Jowar. His uncle*	Methodology

explained the difference between the seed type and climatic prerequisite of growing them.

Although Jowar farming had always been profitable, Ameya wanted to explore some other cropping patterns that would go with cash crop farming. Ameya was still not sure which crop to choose from and what parameters the success depends upon. Ameya approached his uncle to take his advice on growing a cash crop. His uncle did seem to talk a lot, but Ameya understood that even his uncle was clueless. He told Ameya to decide fast as the season for sowing the Rabi crop was approaching. But Ameya had still not decided on which crop to sow along with Jowar.

The Teacher will now apply the design thinking framework to the given scenario:

Empathize: The students will now reflect on the scenario:

1. What could be Deen Dayal's age at the time of his death?
2. How much experience did Ameya have in the agricultural sector?
3. Did Deen Dayal have time to pass on his knowledge and legacy to Ameya?
4. Did Ameya have any plans of coming back to Satara?
5. Does he know what cropping patterns mean?
6. Does Ameya understand the meaning of Rabi, Kharif and Zaid seasons?
7. Instead of growing cash crop in his entire farm, he is planning to co-grow a cash crop and Jowar. Is it a good idea? (Hint: Perhaps, he is playing safe, in case the experiment doesn't work, he won't end up losing a everything
8. Is Ameya equipped with sufficient knowledge about farming?
9. Has he decided which cash crop to grow?
10. Was Ameya's uncle knowledgeable?
11. Did Ameya have anyone to depend upon on his decision on choosing the crop?

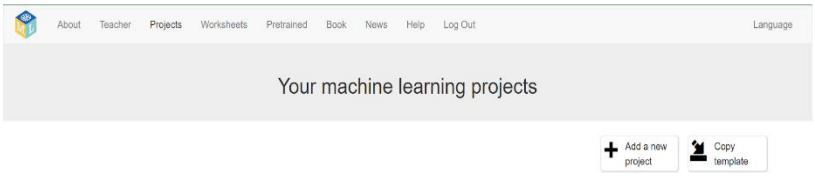
Define: Ask students to identify the problems that Ameya might face in the given scenario. What are the major hurdles in his way to obtaining high yields in their farms?

Ideate: Students to arrive at the solution to identify crops with high yield (cash crops) to earn maximum profit and develop an automatic crop identification system based on Computer Vision. ***Teacher can suggest students to come up with another solution/model.***

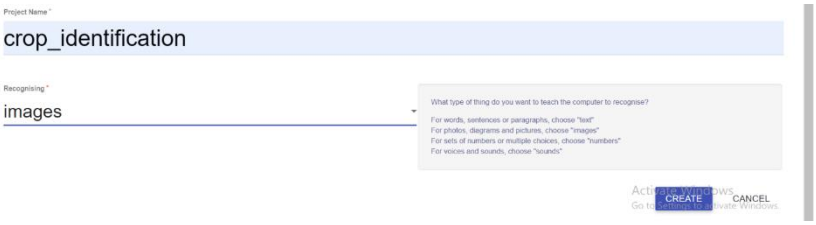
Stage 3: Prototype to develop an AI model for identifying crops (Subject Teacher and AI Faculty).

Students will create an AI model to identify crops (Ex: Rabi and Kharif) - providing the name of the crop, its origin, and more information about the recognized crop. Steps of implementation are:

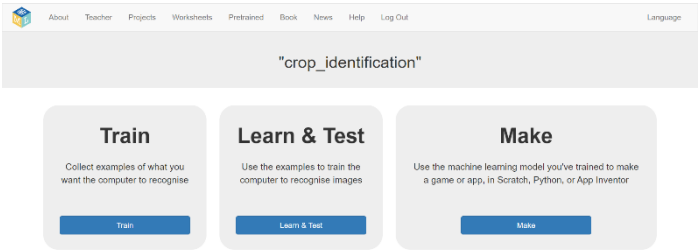
3.1 Visit https://machinelearningforkids.co.uk and "Add a new project"



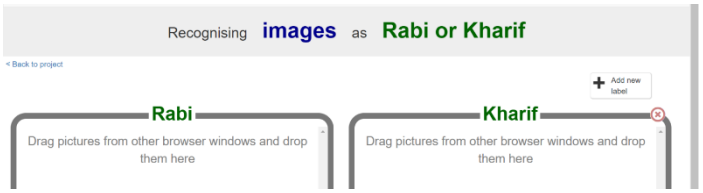
3.2 As name of your project put 'crop_identification' and select **images** under **Recognizing** and click on the **Create**.



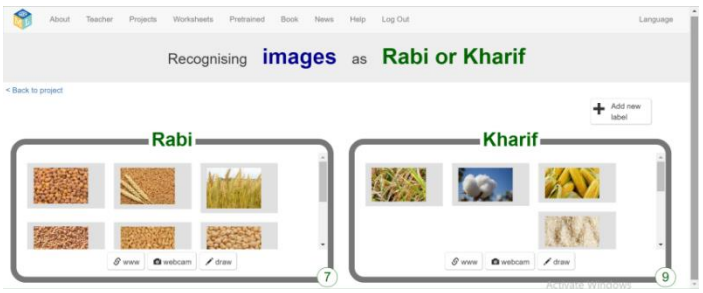
3.3 Click on your project name to train your AI model and then click on **Train**



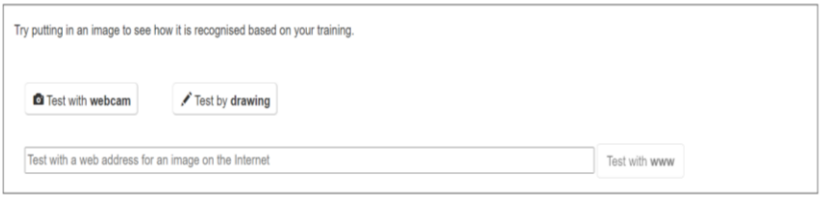
3.4 Click on **Add new label** to create two labels for the two different categories of crop. Name them as 'Rabi' and 'Kharif'



3.5 Now, in another tab, search and download pictures of Rabi crops. Add at least 10 such images under Rabi label. Repeat the same process with Kharif crop images.



3.6 Now, go to **Learn & Test** and click on the **Train new machine learning model**.



3.7 Your AI model is now ready to be tested!

Stage 4: Developing Farmer's App for automatic identification and generating information about the crop of interest (Subject Teacher ATL in charge)

Problem Statement / Scenario:

Ameya benefited a lot from a simple tool that could identify cropping season based on crop pictures. He made another plan, in investing in a mobile app that can help millions of farmers across India to choose from a variety of crops and experiment with growing it on their land.

Empathize: The learners will now reflect on the scenario:

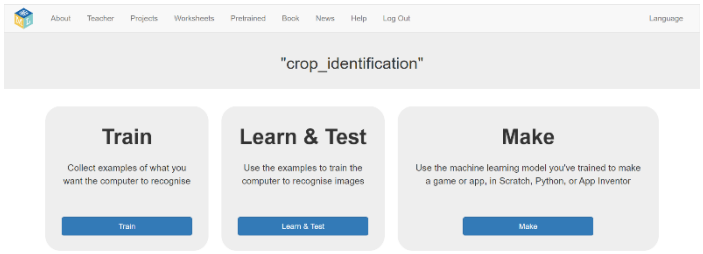
1. Do you think Ameya is a smart investor?
2. How did he benefit from the AI enabled solution?
3. Will a user-friendly mobile app help people like Ameya in obtaining optimal yields from their harvest?

Define: Ask students to identify various features of interest to develop a mobile application to keep farmers upto date with various crop related information.

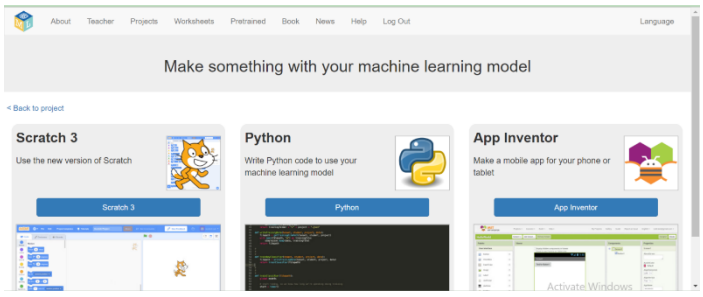
Ideate: Students come up with a plan to develop a mobile application that helps farmers stay up to date with crop-related information. ***Teacher can suggest students to come up with another solution/model.***

Here are the steps to develop a mobile application:

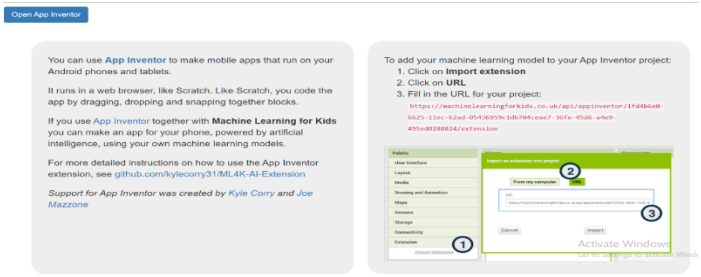
4.1 Go to the **Make** section in the AI project you made in Stage 2.



4.2 Click on the **App Inventor**



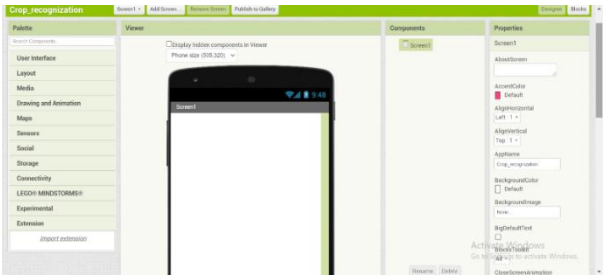
4.3 Copy the URL shown in red and keep it safe



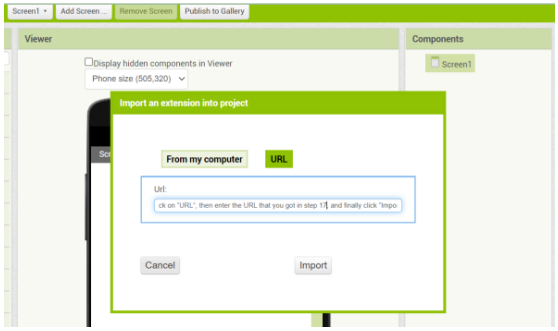
4.4 Click on Open App Inventor and Start a new project

4.5 Name your project as 'Crop_recognization'

4.6 Click on Extension to import your machine learning project



4.7 Click on **URL** and enter the URL that you got in step 3. Then click on **Import**. In some time, a new extension should appear named ML4KComponent.



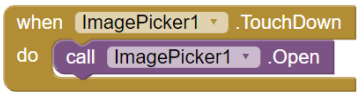
4.8 Drag the Machine Learning for Kids extension (**ML4K**) to the **Viewer**. The icon will be added under the mobile screen under 'non-visible components' list.

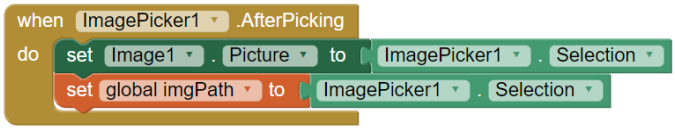
Following elements are used in the app interface:

a. Image picker block from Media
b. Image block from User Interface
c. Label block from User Interface
d. Button block from the User Interface
e. Two labels
f. Web Viewer block

4.9 After finishing the interface layout and design, click on the **Blocks** button in the top right corner of the screen to start creating your script.

4.10 This is how you add the image picker block

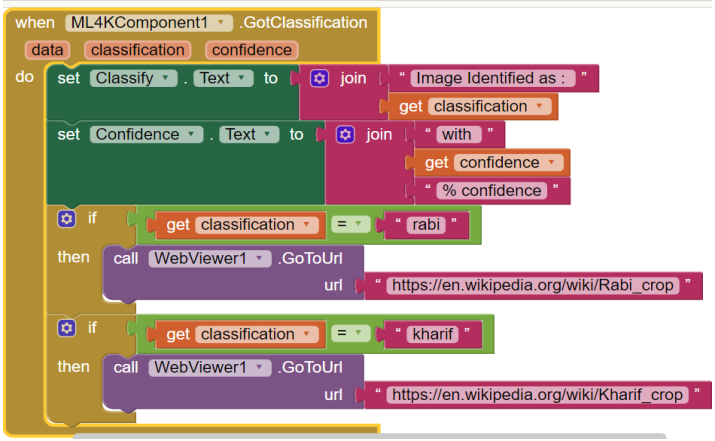




4.11 In the block below, copy and paste the API Key into the ML4K component's **Key** property on the Designer screen. (Note: API Key must be set before you can use any of the ML4K extension blocks for classification)

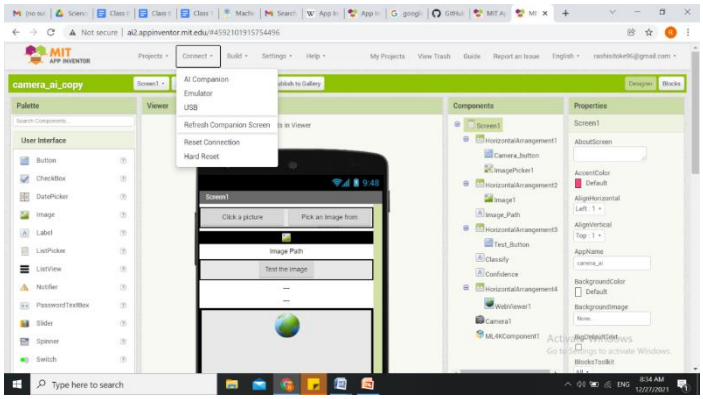
4.12 Now, use the **ClassifyImage** block with the image path to classify.

4.13 Use the **Got Classification** event block to retrieve the classification once it is completed



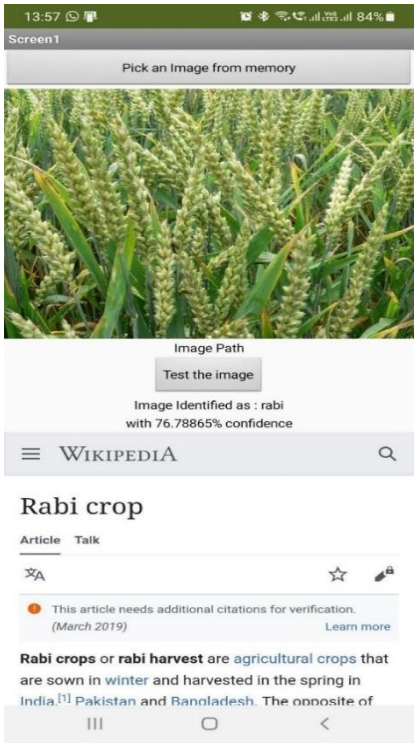
4.14 Now test your app using the MIT AI2 Companion. Download the app from the Play Store by searching for **MIT AI2 Companion**.

4.15 Click on **Connect**. In the drop-down menu, click on **AI Companion**



4.16 Scan the QR code by clicking **Scan QR code** or type the code into the text window and click **Connect with code**

4.17 In some time, the app will load on your phone and you can try to test it with some pictures of crops online. This is what it looks like:



Learning Outcomes	Learners will be able to • Classify the various factors governing crop yield in the form of a flowchart or a mind map. • Apply learning on agricultural practices into providing a complete solution to a farmer. • Apply the interdependency and interrelationship in biotic and abiotic factors of the environment in the context of crop yield. • Create a machine learning model that can identify (visually) different crop categories. • Create mobile applications with customizable interfaces. • Integrate a machine learning model with a phone app.
Glossary	• **Data Acquisition**: Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that are required for the AI model. There can be various ways to collect data. • **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. • **MIT App Inventor** :MIT App Inventor is a visual programming platform that offers us to build apps for Android and iOS smartphones and tablets right in your web browser. Students are encouraged to use their own Android devices for hands-on testing and exploitation. It has App Inventor Designer, where you can select the components for your app and your app appears on the phone step-by-step as you add pieces to it. And In the App Inventor Blocks Editor, you can assemble program blocks that specify how the components should behave. You assemble programs visually, fitting pieces together like pieces of a puzzle. • **MIT AI2 Companion**: The MIT AI2 Companion is an android application tool that enables real-time debugging on a connected device like smartphones and tablets. If you don't have an Android phone, you can build your apps using the Android emulator, software that runs on your computer and behaves just like the phone.
Reference Links	• Video on Climate https://www.youtube.com/watch?v=vH298zSCQzY&ab_channel=NASAClimateChange • Kharif, Rabi and Zaid Season https://learnnaturalfarming.com/cropping-seasons-of-india-kharif-rabi-and-zaid/ • Good read on Crop Yield: https://www.researchgate.net/publication/342994002_Factors_Affecting_Yield_of_Crops • Cash Crops: https://www.99businessideas.com/cash-crops-for-small-farms/#:~:text=Saffron%2C%20Cardamom%2C%20Pure%20Vanilla%20beans%2C%20etc%20are%20considered,profitable%20and%20commercial%20cash%20crops%20to%20grow.%20%2315. • App Inventor: https://appinventor.mit.edu/ • Machine Learning for Kids: https://machinelearningforkids.co.uk/

	• MIT App Inventor App link: https://play.google.com/store/apps/details?id=edu.mit.appinventor.aicompanion3&hl=en_IN&gl=US
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern Recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability **AI domain** • AI for Data and Computer Vision **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Persuasion • Creative mindset **Interpersonal skill** • Empathy • Collaboration **Computational Thinking** • C programming (Arduino)

Class 9
Lesson 9.3
A story of Village Palampur- Chapter 1

Parameters	Description	Note for teachers
Chapter Covered	Chapter 1: A story of Village Palampur	
Name of the Book	NCERT, Social Science Textbook for Class IX	
Learning Objectives	Students will be able to comprehend the lives of the people in the countryside through a case study of Palampur in this chapter. After comprehending the case study, students will be able to recognise the changes that have occurred in Indian villages, grasp that factors of production are necessary for the production of goods and services, and list the fundamental factors of production. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Understand different factors of productions: land, labour, capital. ● Comprehend the farming activities in Palampur as a case study covering land as fixed resource, growing pattern, distribution of land and land sustainability. ● Differentiate between multi-cropping and modern farming and the capital required in farming. ● Comprehend and explain the non-farming activities in Palampur: ● Dairy ● Small scale manufacturing ● Transport (Service sector) ● Differentiate between primary, secondary and tertiary sectors of economy. ● Understand the concept of the Green Revolution and how it started. **AI and Tinkering :** **Stage 2 : Apply Design Thinking framework** ● Understand the applicability of the concepts of Consumer rights and build solution to provide Quality fruits and reject others. **Stage 3: Making a hardware** ● Understand how colour detection works. **Stage 4: Making AI enabled software** ● Develop algorithms to use microcontrollers with color sensor. **Stage 5: Making complex Modeling** ● Build an AI model to predict Fruit quality.	Teacher can conduct BRAINSTORMING session to introduce the topic. EX. Sharing of experiences of children who have been to a village, about different aspect of village life.
Time Required	5 periods of 45 minutes each.	

Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular class room arrangement. ● Activity Sessions – Flexible (for group / pair work).	
Material Required	**Scholastic**: ● Textbook, Smart Board / screen and projector ● Pen and paper ● Laptop or smartphone ● White board and marker **AI and Tinkering :** ● TCS3200 sensor ● Arduino Uno	
Pre – Preparation Activities	**Scholastic**: **Activity:** The teacher organizes a field trip to farms of their region and facilitates an interaction of learners with farmers to develop an understanding of: ● kinds of farming methods used by farmers: Traditional/ Modern/ mixed ● the sources of irrigation ● the sources from where farmers obtain the inputs (Factors of productions) that they require. **AI and Tinkering :** The teacher is required to make arrangements for the hardware required and install the following softwares to conduct the class activity. ● Anaconda Prompt ● Jupyter notebook ● Python 3.6 ● Packages: MatplotLib, Pandas, Scikit Learn, keras and tensorflow	Debate can be conducted on any topic related to the positive impact of farming on nation's future. EX. Future belongs to the nation with Grains not Guns
Previous Knowledge	**Scholastic**: The teacher initiates a whole-class discussion: ● to elicit information on various sectors of economy in India. ● to enable learners to observe and list out different economic activities undertaken in their area. ● brainstorm ideas and make a chart on sector-wise distribution of activities. ● on different types of economic activities in rural and urban setup. The discussion helps the learners to understand different types of activities undertaken and the pattern followed in the rural and urban sector. **AI and Tinkering :** The facilitator helps the learners recapitulate basic knowledge of the following. ● Programming an Arduino UNO Board	

	• Sensor connections and usage • Python Packages: MatPlotLib and Pandas • AI Modeling in Python • **Understand the working of Arduino and the basics of AI.** https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s https://www.youtube.com/watch?v=2ePf9rue1Ao • **Understand the basics of python and its packages** https://aistudent.community/single_course/2021 • **Understanding of Modeling techniques in AI** https://youtu.be/7ZoQt2XlykY • **Understand the basics of neural networks.** https://towardsdatascience.com/a-gentle-introduction-to-neural-networks-series-part-1-2b90b87795bc https://youtu.be/7ZoQt2XlykY • **Basics of evaluation of AI Models.** https://youtu.be/7ZoQt2XlykY	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** The teacher leads the learners into an understanding of different types of farming and non-farming activities through hands-on-experience. **Activity 1.1** • The learners will be asked to fill the proforma based on their interaction with farmers. (Reference Table 1.1 Part C from NCERT book, The story of Village Palampur, at page 4) • The teacher encourages an understanding of the pattern and methods of farming through different sources of irrigation, making the learners reflect on it. **Activity 1.2** • The learners collect details from newspaper/ magazines/ website articles and reports related to the impact of the Green Revolution. • They examine the information to make an association of loss of soil fertility due to increased use of chemical fertilizers and how modern irrigation leads to reduced groundwater levels. • The learners discuss in their groups different ways to conserve the natural resources: soil and water. **Activity 1.3** Teacher initiates a discussion on non-farming activities in Palampur • Dairy • Small scale manufacturing • Transport (Service sector) The discussion will make the learners differentiate between primary, secondary and tertiary sectors of economy. **Contextualization**: **AI and Tinkering :** **Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher)**	

Problem Statement / Scenario: *During recess time at school, Zuhaib and Amit were eating the fruits their mothers packed for them. Both friends always shared their food. Last week, both of them had brought apples. Zuhaib offered his fruit to Amit and ate a slice of apple from his tiffin box. When Amit tasted the apple from Zuhaib's tiffin, he found it quite juicy, while his fruit was not the same. Moreover, he found the skin of his fruit had a shine as if it were coated with wax. Zuhaib also noticed this and told Amit that his uncle had a farm and last week he had brought those apples when he came to visit them. Both the boys were quite confused about the different types of the same fruit.*

Empathize: : Students are asked to brainstorm on the above scenario and they are made to think deeper about it by asking the following questions

1. What does it feel when we eat a low quality fruit?
2. What comes in your mind if you see a wax like coating on fruits?
3. Are dull looking fruit good in quality or are shiny looking fruit of good quality?

Define: To understand the problem in detail the students are asked to ponder on following questions

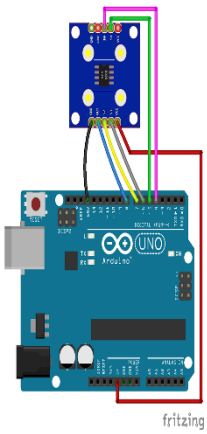
1. Have you come across such a situation?
2. What do you think the wax was on the fruit?
3. Can you think of a solution to solve this problem?

Ideate: Students will now be asked to come up with different alternatives to check the quality of fruit available in the market. (hint Fruit quality prediction using RGB sensor)

Stage 3: Developing Fruit quality prediction using RGB sensor (Subject Teacher and ATL Incharge)

3.1 Making the Hardware:

In this module the learners will learn how to detect colours with the Arduino and the TCS230 / TCS3200 colour sensor and thereby detect the quality of the fruit. They will make the Hardwar using the following Schematics



3.2 Algorithm

After connecting the hardware according to the schematic, the next step is to make an algorithm to understand the flow of the program.

Following are the key steps to develop an understanding of the same:

Step 1: Data Collection: In order to understand the correlation between Fruit colour and fruit quality, there is a need to collect the data from the color sensors.

- Defining the Pins through which data will be collected from Arduino UNO
- Input is taken from TCS3200 sensor
- The values are stored in variables

Step 2: Data Processing: The data that is received from the sensors is raw in its stage, and there is a need to process them to make it ready for training. Data received is processed through Color sensor

Step 3: Data Transfer: Finally, after processing the data, the data is transferred to the system through serial communication using USB Cable. The processed data is sent from Arduino to the system.

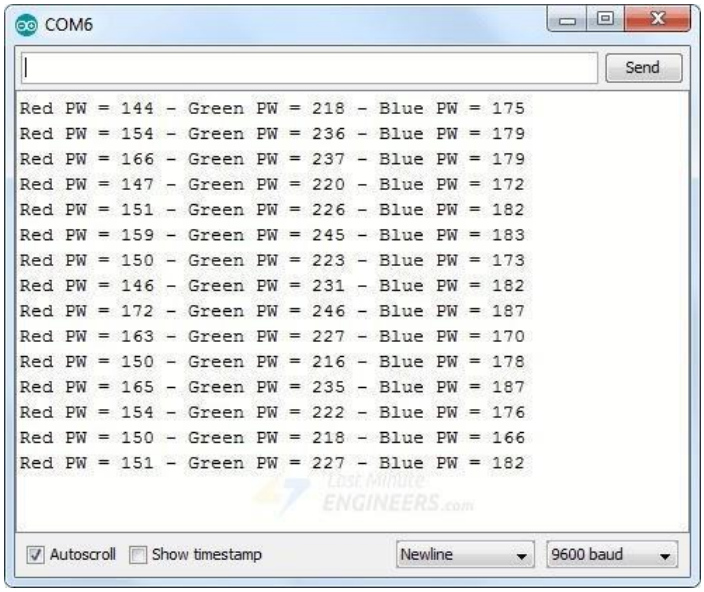
- All the processed data to be transferred is stored in a String.
- The data is sent using Serial Communication every time the colour of fruit is scanned.

3.3 **Below** mentioned code is written in the Arduino IDE and uploaded to start getting values from the sensor.

```
// TCS230 or TCS3200 pins wiring to Arduino
#define S0 4
#define S1 5
#define S2 6
#define S3 7
#define sensorOut 8

// Stores frequency read by the photodiodes
int redFrequency = 0;
int greenFrequency = 0;
int blueFrequency = 0;

void setup() {
 // Setting the outputs
 pinMode(S0, OUTPUT);
 pinMode(S1, OUTPUT);
 pinMode(S2, OUTPUT);
 pinMode(S3, OUTPUT);

 // Setting the sensorOut as an input
 pinMode(sensorOut, INPUT);

 // Setting frequency scaling to 20%
 digitalWrite(S0,HIGH);
 digitalWrite(S1,LOW);

 // Begins serial communication
 Serial.begin(9600);
```

```
}
void loop() {
 // Setting RED (R) filtered photodiodes to be read
 digitalWrite(S2,LOW);
 digitalWrite(S3,LOW);

 // Reading the output frequency
 redFrequency = pulseIn(sensorOut, LOW);

  // Printing the RED (R) value
 Serial.print("R = ");
 Serial.print(redFrequency);
 delay(100);

 // Setting GREEN (G) filtered photodiodes to be read
 digitalWrite(S2,HIGH);
 digitalWrite(S3,HIGH);

 // Reading the output frequency
 greenFrequency = pulseIn(sensorOut, LOW);

 // Printing the GREEN (G) value
 Serial.print(" G = ");
 Serial.print(greenFrequency);
 delay(100);

 // Setting BLUE (B) filtered photodiodes to be read
 digitalWrite(S2,LOW);
 digitalWrite(S3,HIGH);

 // Reading the output frequency
 blueFrequency = pulseIn(sensorOut, LOW);

 // Printing the BLUE (B) value
 Serial.print(" B = ");
 Serial.println(blueFrequency);
 delay(100);
}
```

3.4 Once the code has been uploaded, the serial monitor is opened to start receiving values from the sensor. A sample snippet is mentioned below for reference:



Now that the data from the sensor is flowing, the next step is to figure out how this data can be used to solve the problem.

Stage 4: Making the AI enabled software to predict the quality of the food (Subject teacher and AI Faculty)

4.1 Importing data from Hardware

In the previous section, a hardware prototype was made using the following components:

- TCS3200 color sensor - to scan the colour of fruit
- Arduino Uno: to collect data from both the sensors and control them.

Step1: Data Visualization & Exploration

- The first and the foremost step is to store this data. In order to do so, the data must be captured from the serial monitor and stored in a csv (comma separated values) file for further usage. The values in the csv will be noted by measuring from the arduino.
- In this section the learners will explore the ways the data collected from various sensors and stored in a CSV file can be used in order to create an AI model. The data would be cleaned and made ready to be used for training a model. In order to do so in python, the packages Pandas and MatplotLib are used.
- In the current example, data collected is RGB data of the fruit colour, which is being stored in the form of a csv file at regular intervals of time.
- Let us now use python packages to visualize the data captured.

```
import pandas as pd
 # reading csv file
data = pd.read_csv('file_path')
 # shape of dataset
print("Shape:", data.shape)
 # column names
print("\nFeatures:", data.columns)
```

```
# storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]
# printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())

# printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

- As visualized, the relation is between the colour data and the fruit quality, the next step is to create a model which can predict the fruit quality based on the above parameters.

Step 2: In order to achieve this, there is a need to create a labelled dataset which can be used to train the model for classifying the fruit quality as per the colour data.

Fresh Apples Fresh Bananas Fresh Oranges

Rotten Apples Rotten Bananas Rotten Oranges

This can be done by deliberately using different types of fruits:

1. Option 1: Use rotten fruits
2. Option 2: Make the first test, and keep fruits out in the environment for a period of a day or two and use them again.

The data captured after following either of the above-mentioned steps needs to be labelled as per the labels: Fresh or Rotten. An example of the data is given below.

Stage	R Data	G data	B data	Label
Fresh Apple	199	57	49	1
Rotten Apple	121	63	13	0
Fresh Banana	237	195	73	1
Rotten Banana	180	168	81	0
Fresh Orange	247	202	5	1
Rotten Orange	212	98	18	0

Here,

0 – Rotten

1 – Fresh

The data captured needs to be labelled in this manner in order to make it ready for training a model.

Step 3: Modeling and Evaluation

Once the data is labelled and ready for use, the next step is to train the model.

In the current project, the example is a classification problem, and using the Scikit learn cheat sheet, the learner will use the SciKitLearn package to train the classification model.

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(X, y)
output = knn.predict([[200]])
```

Once the model is trained, the next step is to check whether the model is working correctly or not. This comes under the stage Evaluation of the AI Project Cycle.

This can be done by real time scanning of the fruit colour and getting the predictions out of it.

Stage 5: Use complex AI Modeling technique (Subject teacher and AI Faculty)

- In the previous stage, it started with scanning the colour of fruits in order to understand the fruit quality
- To take this forward, the next step is to try complex Modeling techniques on the same data set and compare the performance of both the models.
- In this stage, the learner will work around training a neural network using deep learning techniques.
- Given below is a training of neural networks on the already available labelled data for the RGB data of the fruit colour.

5.1 Data Reading

```
import pandas as pd
 # reading csv file
data = pd.read_csv('/content/fruit_color_data - Sheet1.csv')
# shape of dataset
print("Shape:", data.shape)
 # column names
print("\nFeatures:", data.columns)
 # storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]
 # printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())
```

```
 # printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

5.2 Model designing and training:

```
import numpy as np
from tensorflow.python.keras.layers import Input, Dense
from tensorflow.python.keras.models import Model
input1 = Input(shape=(1,))
l1 = Dense(10, activation='relu')(input1)
l2 = Dense(50, activation='relu')(l1)
l3 = Dense(50, activation='relu')(l2)
out = Dense(2)(l3)

model = Model(inputs=input1, outputs=[out])
model.compile(
  optimizer='adam',
  loss=['mean_squared_error']
  )
history = model.fit(X, y, epochs=1000, batch_size=2)
```

5.3 Output :

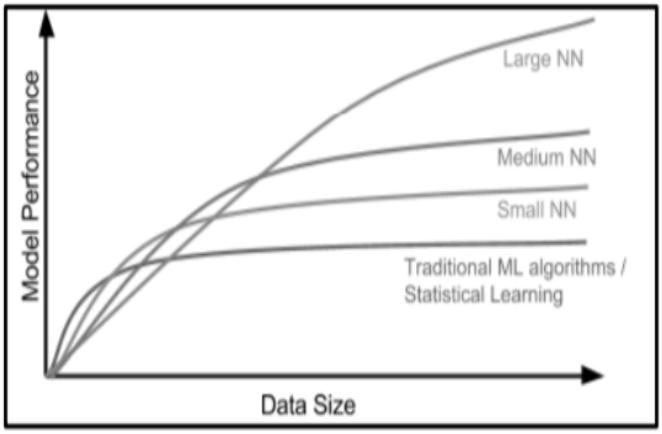
```
y_predict = model.predict([2])
```

5.4 Observation:

After the model is trained, the prediction of fruit quality is received using the Neural Network and KNN model.

It is observed that the performance of both the models is different. The next step is to try and check the performance of the model by increasing the amount of data.

This is to observe that the performance of the model varies as per the amount of data used for training a model. The relation between the model performance and data size varies as per the below mentioned graph.



	Must Try: One can try changing the dataset size and map it with the performance of the models.
Learning Outcomes	The learner will be able to: ● understand different factors of productions: land, labour, capital. ● explain the differences between multi cropping and modern farming and the capital required in farming. ● understand the concept of the Green Revolution and its positive impact. ● able to differentiate between primary, secondary and tertiary sectors of economy. ● plan and conduct investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own. ● understand applicability of the concepts of Consumer rights and build solution to provide Quality fruits and reject others. ● relate processes and phenomena with causes and effects, apply scientific concepts in daily life and in solving problems.
Glossary	● **Color Sensor**: The TCS3200 color sensor can detect a wide variety of colours based on their wavelength. This sensor is especially useful for color recognition projects such as color matching, color sorting, test strip reading and much more. ● **Arduino Uno**: is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins. ● **Serial Communication**: Serial is used for communication between the Arduino board and a computer or other devices. All Arduino boards have at least one serial port (also known as a UART or USART): Serial. It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB. ● **Data Labelling**: In machine learning, data labelling is the process of identifying raw data (images, text files, videos, etc.) and adding one or more meaningful and informative labels to provide context so that a machine learning model can learn from it. ● **CSV:** A comma-separated values (CSV) file is a delimited text file that uses a comma to separate values. Each line of the file is a data record. Each record consists of one or more fields, separated by commas. ● **SKLearn Package**: scikit-learn is an open source Machine Learning Python package that offers functionality supporting supervised and unsupervised learning. ● **MatplotLib**: Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy. ● Modeling is the process of training the model on the available dataset in order to get a prediction when provided with an input. ● **Neural Networks** :Neural networks are loosely modelled after how neurons in the human brain behave. The key advantage of neural networks is that they are able to extract data features automatically without needing the input of the programmer. A neural network is essentially a system of organising machine learning algorithms to perform certain tasks. ● **KNN Model** : K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning

Skill outcomes	**Tech skill** ● Digital learning ● Algorithmic thinking ● Data gathering ● Pattern Recognition ● Model optimization **Design thinking** ● Ideation ● Prototyping **Mathematical and quantitative skills** ● Probability **AI domain** ● AI for Data **Physical computing** ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network **Social impact solution building** ● Problem identifying ● Problem scoping ● Problem solving ● Prototyping the AI and tinkering solution **Intrapersonal skill** ● Observation skill ● Persuasion ● Creative mindset **Interpersonal skill** ● Empathy ● Collaboration **Computational Thinking** ● C programming (Arduino)

Class 9
Lesson 9.4
Food Security in India- Chapter 4

Parameters	Description	Note for teachers
Chapter Covered	Chapter 4: Food Security in India	
Name of the Book	NCERT, Economics Textbook for Class IX	
Learning Objectives	Food security refers to the constant availability, affordability, and accessibility of food for all people. Students will learn about and comprehend the role played by the government in guaranteeing a supply of food in this session. Food security issues are brought on by a Variety of natural and man-made disasters. Describe the fundamental components of food security and the difficulties the government faces. I'll discuss the benefits and drawbacks of PDS and other options. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Analyze the contribution of the government in ensuring food supply. ● Infer the basic features of food security and challenges faced by the government. ● Realize the need for food security in various situations. ● Get familiarized with the problems in the public distribution system and look for alternative solutions. ● Explain the merits and demerits of PDS and alternative solutions. ● Develop clear understanding about the role of government to protect the weaker sections of society. **AI and Tinkering** **Stage 2 : Apply Design Thinking framework** ● Infer the basic features of food security and challenges faced by the government. ● Realize the need for food security in various situations. ● Understand the applicability of the concepts of Stock Buffer and build solutions to prevent the germination of the grains by keeping them in dry conditions <14% RH. ● Understand how Temperature/ Humidity detection works. **Stage 3: Making a hardware** ● Get familiarized with the problems in the public distribution system and look for alternative solutions. ● Explain the merits and demerits of PDS and alternative solutions. ● Build an AI model to predict accuracy of the Temperature / Humidity and its effect on the buffer stock. **Stage 4: Making AI enabled software** ● Develop algorithms to use microcontrollers with DHT sensor. **Stage 5: Making complex Modeling** ● Combine their knowledge around sensor technology with electronics and AI to create their own project.	The teacher can develop a ppt to elaborate the topic. Discussion method can be practiced to understand the three dimensions of food security, namely - availability, affordability and accessibility.

Time Required	6 periods of 45 minutes each	
Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular class room arrangement ● Activity Sessions – Flexible (for group / pair work)	
Material Required	**Scholastic**: ● Textbook ● Smart Board / screen and projector ● Pen and paper ● Laptop or smartphone ● White board and marker **AI and Tinkering :** ● DHT11 sensor ● Arduino Uno	
Pre – Preparation Activities	**Scholastic**: **Activity:** The teacher organises a visit to Food Corporation office of their region and facilitates an interaction of learners with officer to develop an understanding of: ● buffer stock. ● the sources of procurement of food grain. ● arrangement made to ensure the quality of food grain. **AI and Tinkering :** The teacher makes arrangements for the hardware required and installs the following softwares to conduct the class activity. ● Anaconda Prompt. ● Jupyter notebook. ● Python 3.6 ● Packages: MatplotLib, Pandas, Scikit Learn, keras and tensorflow.	
Previous Knowledge	**Scholastic**: The teacher facilitates the learners to recall the related terms by initiating a discussion through the following questions, before introducing the chapter. ● What steps have been taken by the government to remove hunger and malnourishment? ● Why has the government started the midday meal scheme? **AI and Tinkering :** The facilitator helps the learners recapitulate basic knowledge of the following. ● Programming an Arduino UNO Board ● Sensor connections and usage ● Python Packages: MatPlotLib and Pandas ● AI Modeling in Python	

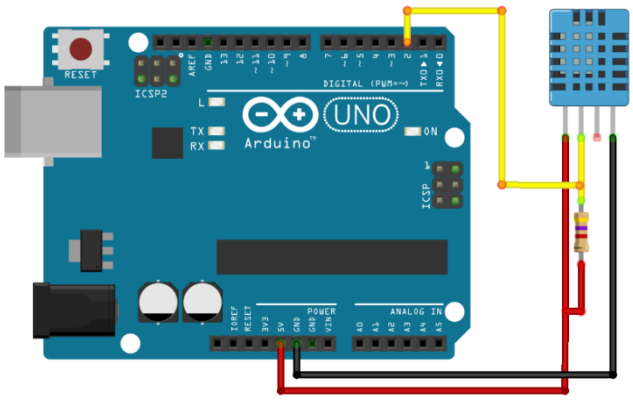
	• **Understand the working of Arduino and the basics of AI.** https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s https://www.youtube.com/watch?v=2ePf9rue1Ao • **Understand the basics of python and its packages.** https://aistudent.community/single_course/2021 • **Understanding of Modeling techniques in AI** https://youtu.be/7ZoQt2XlykY • **Understand the basics of neural networks.** https://towardsdatascience.com/a-gentle-introduction-to-neural-networks-series-part-1-2b90b87795bc https://youtu.be/7ZoQt2XlykY • **Basics of evaluation of AI Models.** https://youtu.be/7ZoQt2XlykY	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** 1. Introduces the topic – food security by a news report by CNN IBN LIVE and asks students why food security is essential in India. 2. Discusses various terms like availability, affordability, accessibility, buffer stock, MSP, issue price, subsidy, rationing, famine and how these terms are related to food security. 3. Discusses the schemes and programmes started by the government to provide food security in India and how PDS has been revamped by the Indian government to improve and ensure food security. **Contextualization**: **AI and Tinkering**: **Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher & ATL in-charge)** **Problem Statement / Scenario:** *Alisha and Akshita read the recent news about spoiling and wastage of grains at a warehouse due to humidity. They were shocked to read about tons of food being wasted, while innumerable poor people sleep with an empty stomach every night. They bring up this concern during discussion with the teacher in their Social Science class regarding the causes and precautions to be taken for food security.* The facilitator will now apply the design thinking framework on *Alisha and Akshita* scenario. **Empathize:** The students will now reflect on the scenario: 1. Where did Alisha and Akshita read the news about spoiling and wastage of grains at a warehouse due to humidity. 2. Why were they shocked to read about tons of food being wasted? 3. Can you relate to this problem? 4. What do you think is the relation between temperature and humidity on food grains getting spoiled? 5. What precautions do you think you all can come up for food security by ensuring optimum environment conditions? **Define:** Ask students to initiate and give some suggestions by discussing in your groups how you can help Alisha and Akshita find a solution to the problem of food wastage?	

Ideate:
Students will now be asked to come up with solutions to ensure how proper mechanisms for storage of food grains can be carried out by measuring ambient temperature and humidity and thereby detecting optimum environmental conditions for the buffer stock.

Stage 3: Making a hardware to measuring ambient temperature and humidity using Arduino Uno & the DHT11 sensor- tinkering (Subject teacher and ATL in-charge)

3.1 Making the Hardware: In this module the learners will learn how to measure ambient temperature and humidity using Arduino Uno & the DHT11 sensor and thereby detect optimum environment conditions for the buffer stock.

The DHT11 is a **basic, ultra low-cost digital temperature and humidity sensor**. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and gives out a digital signal on the data pin (no analog input pins needed). Develop the hardware using the following schematics.



3.2 Algorithm : After connecting the hardware according to the schematic, the next step is to make an algorithm to understand the flow of the program using the following steps:

Step 1 :Data Collection

In order to understand the ambient temperature and humidity, there is a need to collect the data from the DHT sensor.

- Defining the Pins through which data will be collected from Arduino UNO
- Taking Input from DHT11 sensor
- Storing the values in variables

Step 2 :Data Processing

The data that is received from the sensors is raw in its stage, and there is a need to process them to make it ready for training.

- Data received is processed through Humidity sensor
- Data Transfer:

Step 3: Data Transfer

Finally, after processing the data, the data is transferred to the system through serial communication using USB Cable. All the processed data to be transferred is stored in a String.

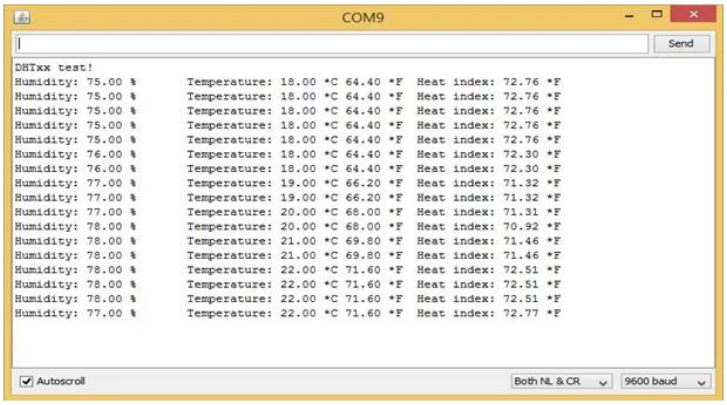
The data is sent using Serial Communication every time the sensor data is read.

Below mentioned code is written in the Arduino IDE and uploaded to start getting values from the sensor.

```
#include "DHT.h"
#define DHTPIN 2    // what pin we're connected to
// Uncomment whatever type you're using!
#define DHTTYPE DHT11  // DHT 11
//#define DHTTYPE DHT22  // DHT 22  (AM2302)
//#define DHTTYPE DHT21  // DHT 21 (AM2301)
// Initialize DHT sensor for normal 16mhz Arduino
DHT dht(DHTPIN, DHTTYPE);
void setup() {
Serial.begin(9600);
Serial.println("DHTxx test!");
 dht.begin();
}
void loop() {
// Wait a few seconds between measurements.
delay(2000);
 // Reading temperature or humidity takes about 250 milliseconds!
// Sensor readings may also be up to 2 seconds 'old' (it's a very slow sensor)
float h = dht.readHumidity();
// Read temperature as Celsius
float t = dht.readTemperature();
// Read temperature as Fahrenheit
float f = dht.readTemperature(true);

// Check if any reads failed and exit early (to try again).
if (isnan(h) || isnan(t) || isnan(f)) {
 Serial.println("Failed to read from DHT sensor!");
        return;
}
 // Compute heat index
// Must send in temp in Fahrenheit!
float hi = dht.computeHeatIndex(f, h);
 Serial.print("Humidity: ");
Serial.print(h);
Serial.print(" %\t");
Serial.print("Temperature: ");
Serial.print(t);
Serial.print(" *C ");
Serial.print(f);
Serial.print(" *F\t");
Serial.print("Heat index: ");
Serial.print(hi);
```

```
 Serial.println(" *F");
}
```

Once the code has been uploaded, the serial monitor is opened to start receiving values from the sensor. A sample snippet is mentioned below for reference:



- Now that the data from the sensor is flowing, the next step is to figure out how this data can be used to solve the problem.

Stage 4: Making AI enabled software (Subject teacher and AI Faculty)

4.1 Importing data from Hardware

Once the hardware is set up, data is collected from the sensors at regular intervals. Now the question arises, what will we do with this data?

4.2 Store the data

The first and the foremost step is to store this data. In order to do so, the data must be captured from the serial monitor and stored in a csv (comma separated values) file for further usage. The values in the csv will be noted by measuring from the arduino.

4.3 Data Visualization & Exploration

- Once the data acquisition part of the AI Project cycle is done, the next stages are Data Visualization and Exploration.
- In this section the learners will explore the ways the data collected from various sensors and stored in a CSV file, can be used in order to create an AI model.
- In the current example, data collected is analog Air quality measurements, which is being stored in the form of a csv file at regular intervals of time.

Let us now use python packages to visualize the data captured.

```
import pandas as pd
 # reading csv file
data = pd.read_csv('file_path')
 # shape of dataset
print("Shape:", data.shape)
 # column names
print("\nFeatures:", data.columns)
```

```
# storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]
# printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())

# printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

- As visualized, the relation is between temperature and humidity, the next step is to create a model which can predict the quality of buffer stock according to the storage temperature and humidity.
- In order to achieve this, there is a need to create a labelled dataset, which can be used to train the model for classifying analog readings as per the AQI data.

This can be done by deliberately using different buffer stock samples:

1) Option 1: sprinkle water over/around the buffer stock

2) Option 2: Put the buffer stock around water pot / jug

- The data captured after following either of the above-mentioned steps needs to be labelled as per the labels: Long-time stock or short-time stock. An example of the data is given below.

Stage	Temp	Humidity	Label
Long-time stock	121	121	1
Short-time stock	199	199	1

Here,
0 – long-time stock
1 – short-time stock

The data captured needs to be labelled in this manner in order to make it ready for training a model.

4.4 Modeling & Evaluation

Once the data is labelled and ready for use, the next step is to train the model. In the current project, the example is a classification problem, and using the Scikit learn cheat sheet, we will use the SciKitLearn package to train our classification model.

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(X, y)
output = knn.predict([[200]])
```

- Once the model is trained, the next step is to check whether the model is working correctly or not. This comes under the stage evaluation of the AI Project Cycle.
- This can be done by real time temperature and humidity monitoring to predict the food quality.

Stage 5: Making complex Modeling technique for AI enabled software (Subject teacher and AI Faculty)

- The next step is to try complex Modeling techniques on the same data set and compare the performance of both the models. In this stage, the learner will work around training a neural network using deep learning techniques. In order to do so, let us start with understanding what a neural network is.
- Given below is a training of neural networks on the already available labelled data for the AQI readings from the sensor.

5.1 Data Reading

```
import pandas as pd
 # reading csv file
data = pd.read_csv('/content/TEMP_HUM_readings - Sheet1.csv')
# shape of dataset
print("Shape:", data.shape)
 # column names
print("\nFeatures:", data.columns)
 # storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]
 # printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())
 # printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

5.2 Model designing and training:

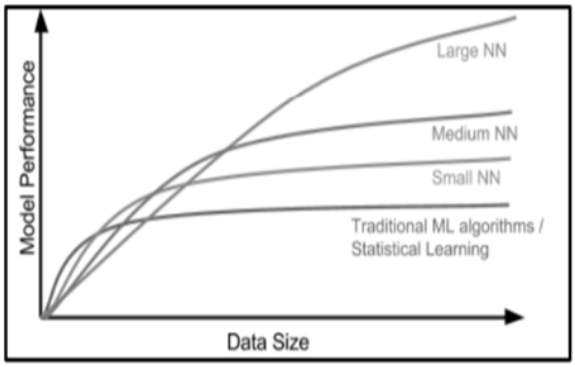
```
import numpy as np
from tensorflow.python.keras.layers import Input, Dense
from tensorflow.python.keras.models import Model

 input1 = Input(shape=(1,))
l1 = Dense(10, activation='relu')(input1)
l2 = Dense(50, activation='relu')(l1)
l3 = Dense(50, activation='relu')(l2)
out = Dense(2)(l3)

model = Model(inputs=input1, outputs=[out])
model.compile(
  optimizer='adam',
  loss=['mean_squared_error']
  )

history = model.fit(X, y, epochs=1000, batch_size=2)
```

5.3 Output :

```
y_predict = model.predict([2])
```

Observation:

- After the model is trained, the prediction of food quality is received using the Neural Network and KNN model.

	• It is observed that the performance of both the models is different. The next step is to try and check the performance of the model by increasing the amount of data. • This is to observe that the performance of the model varies as per the amount of data used for training a model. The relation between the model performance and data size varies as per the below mentioned graph.  **Must Try**: One can try changing the dataset size and map it with the performance of the models.
Learning Outcomes	The learner will be able to • analyse the contribution of the government in ensuring food supply. • understand the basic features of food security and challenges faced by the government. • relate to the problems in the public distribution system and look for alternative solutions. • compare the merits and demerits of PDS and alternative solutions. • determine the role of government to protect the weaker sections of society.
Glossary	**Arduino Uno:** Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins. • **Serial Communication**: Serial is used for communication between the Arduino board and a computer or other devices. All Arduino boards have at least one serial port (also known as a UART or USART): Serial. It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB. • **Digital Signal**: A digital signal is a signal that represents data as a sequence of discrete values. A digital signal can only take on one value from a finite set of possible values at a given time. • **Data Labelling**: In machine learning, data labeling is the process of identifying raw data (images, text files, videos, etc.) and adding one or more meaningful and informative labels to provide context so that a machine learning model can learn from it. • **CSV**: A comma-separated values (CSV) file is a delimited text file that uses a comma to separate values. Each line of the file is a data record. Each record consists of one or more fields, separated by commas. • **SKLearn Package**: scikit-learn is an open source Machine Learning Python package that offers functionality supporting supervised and unsupervised learning. • **KNN Model**: K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning

	• **String** : In Python, string is an immutable sequence data type. It is the sequence of Unicode characters wrapped inside single, double, or triple quotes. • **AI Project Cycle**: project cycle is the life cycle of an A.I. project defining each and every step that needs to be done to develop the project
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern Recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability **AI domain** • AI for Data **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Persuasion • Creative mindset **Interpersonal skill** • Empathy • Collaboration **Computational Thinking** C programming (Arduino)

Class 10
Lesson 10.1
Electricity: Chapter 12

Parameters	Description	Note for teachers
Chapter Covered	Chapter 12- Electricity	This Lesson Plan shall be taken after teaching the Chapter 12
Name of the Book	NCERT, Science Textbook for Class X	
Learning Objectives	This chapter covers the detailed conceptual knowledge about electricity and its effect. In addition, it also introduces the concept of electric power dissipation and application. Through this lesson plan, learners will be able to use the combined knowledge on electricity and power dissipation to identify fault in home appliance. To enhance the learner's understanding on **Scholastic** **Stage 1: Conceptualization** ● Figuring out the relation between voltage and the load resistance. ● The relationship between current drawn and power consumption. ● Lending its application in detecting a faulty device and reducing the electricity bill. **AI + Tinkering** **Stage 2: Contextualization by applying Design Thinking framework** ● Identifying possible reasons behind the increase in electricity consumption ● Identifying the unintentional rise in the energy consumption owing to the faulty devices ● New possible solutions to detect whether a device is faulty or not. ● Open and closed circuits **Stage 3: Prototype to make a device to track the electrical characteristics of a device** ● Writing code to collect data into a csv file from the serial monitor. ● Creating a system to track electrical characteristics of a device, such as power, current etc. **Stage 4: Enable the circuit with AI for Identification and communication upon fault detection**	

	• How to use sensors to track power consumption. • Developing an efficient and smart system to inform users about real-time efficiency and malfunctions. • **AI enabled-**fault detection and notification of a faulty device	
Time Required	4 periods of 40 minutes each	
Classroom/ATL Arrangement	Seating arrangement - • Theory Sessions – regular classroom arrangement • Activity Sessions – Flexible (for group / pair work)	
Material Required	• Smart Board/screen • Projector • Laptop or smartphone • Whiteboard and marker • Copper Tape • Cello Tape • Button Cells • LEDs • Cardboard • Arduino UNO • ACS712 5A Current Sensor • 9V Battery • Connecting wires • DC Fan • Arduino UNO Board • Jumper Wires • Python IDE • Python Packages: Scikit-learn and Pandas	
Pre – Preparation Activities	Students should have basic understanding of • Electricity • Python	
Previous Knowledge	**Scholastic:** • Power = Voltage X Current. • Concept of force on a current carrying conductor placed in an external magnetic field. • Working principle of a DC/AC motor. **Tinkering:** • Basic knowledge of copper tapes and paper circuits. • Basic knowledge of sensors and its purpose. • Using electronic components to form basic circuits by connecting in different ways. • Basic concepts of Python programming – how to write a code and execute it.	

Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** The teacher sets the tone by asking the following questions: ● Has any electric appliances ever broken down in your house? If yes, why? ● How can you protect the electrical devices from breaking down? ● What happens when you run a faulty device? (Hint: motor draws more power than its standard specification, increases the electricity bill, breaks-down in near future, etc.) Teacher manoeuvres the discussion on identifying an increase in the electricity bill as one of the consequences of faulty devices, whose main working element is a DC or an AC motor. ***The teacher must express the difference between AC and DC current through a powerpoint presentation or a video.*** **Contextualization**: **AI and Tinkering**: **Stage 2: Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario and the identification of faulty device (Subject Teacher and ATL In charge)** **Problem Statement/Scenario:** *Mrs Mittal is a middle-aged teacher and lives in a joint family. She had worked very hard for years and now wanted to bring a few electrical home appliances to make her life more comfortable. During the Autumn Festival offer, she bought a brand-new washing machine, a mixer grinder and a vacuum cleaner. It was working fine, but the first electricity bill increased 3 folds. When her son Aayush, who was pursuing his engineering degree from IIT Chennai, visited her, he advised, Mrs. Mittal to call a company technician to have all devices checked. The technician informed them that the washing machine's motor was faulty and needed replacement. Mrs. Mittal was perplexed.* **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. Why did Mrs. Mittal work hard for years? 2. How are the financial conditions of Mrs. Mittal? 3. How do electrical appliances make her life easier? 4. What was the problem? 5. How did his son help her? 6. What could be the reason behind the fault occurring in the motor? 7. Why was Mrs Mittal perplexed? 8. What exactly was the problem being faced in the scenario above? **Define:** Ask students to identify possible reasons behind the increase in electricity consumption and to identify the unintentional rise in the energy consumption owing to the faulty devices that disrupt the monthly budget caused by increased electricity bills. **Ideate:** Ask students to identify possible solutions to detect whether a device is faulty or not. Facilitator talks about how circuits break and asks learners to create a paper circuit that describes open and closed circuits.

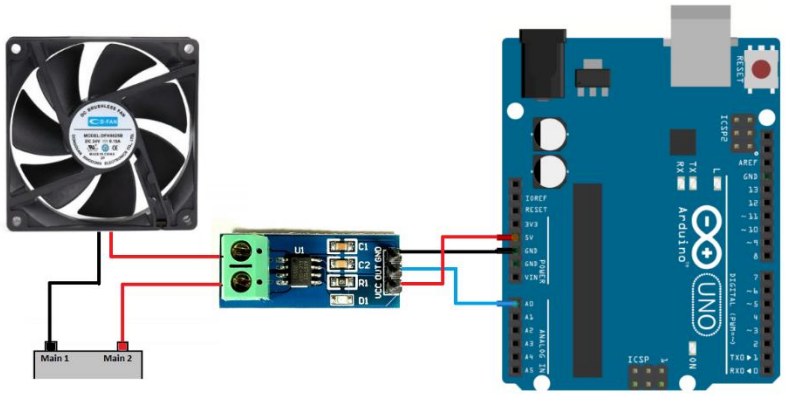
With the help of copper tape, an LED and a button cell, ask learners to make a paper circuit where one end is kept open and acts as a switch.

Learners may use their creativity to create different designs on the switch to turn the LED on and off accordingly.

Ask learners to think of various ways in which they can track the electrical characteristics of a device.

Stage 3: Prototype to make a device to track the electrical characteristics of a device (Subject teacher and ATL in charge).

3.1 Make a circuit connecting Arduino UNO with a DC Fan and a 9V battery through a current sensor as per the following schematic



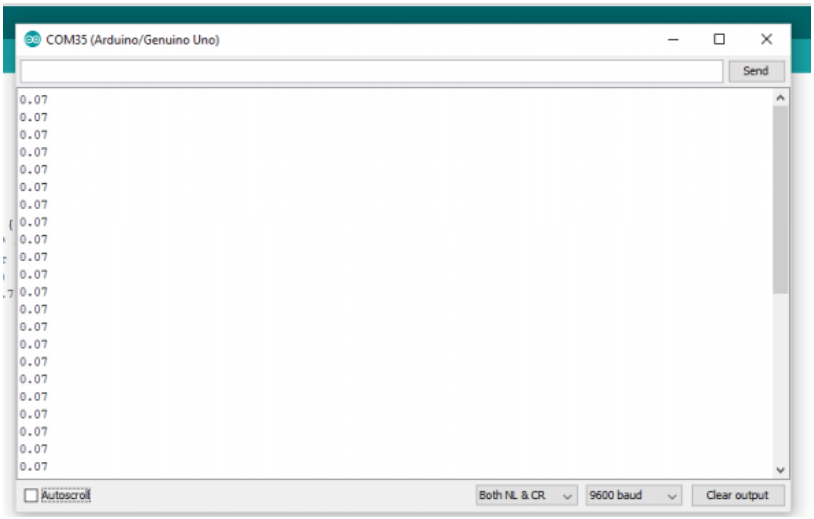
3.2

3.3 Upload the following code to look at the data being captured by the current sensor in the Serial monitor:

```
void setup() {
 Serial.begin(9600); //Start Serial Monitor to display current read
value on Serial monitor
}

void loop() {
unsigned int x=0;
float AcsValue=0.0,Samples=0.0,AvgAcs=0.0,AcsValueF=0.0;

 for (int x = 0; x < 150; x++){ //Get 150 samples
 AcsValue = analogRead(A0);    //Read current sensor values
 Samples = Samples + AcsValue;  //Add samples together
 delay (3); // let ADC settle before next sample 3ms
}
AvgAcs=Samples/150.0;//Taking Average of Samples
```

```
//((AvgAcs * (5.0 / 1024.0)) is converitng the read voltage in 0-5 volts
//2.5 is offset(I assumed that arduino is working on 5v so the viout at no current comes
//out to be 2.5 which is out offset. If your arduino is working on different voltage than
//you must change the offset according to the input voltage)
//0.185v(185mV) is rise in output voltage when 1A current flows at input
AcsValueF = (2.5 - (AvgAcs * (5.0 / 1024.0)) )/0.185;

Serial.print(AcsValueF);//Print the read current on Serial monitor
delay(50);
}
```

3.4 Here's what the output would look like – value of current:



Stage 4: Enable the circuit with AI for Identification and communication upon fault detection (Subject Teacher and AI Faculty).

Empathise: Ask learners to discuss on the following questions:

1. What should Mrs Mittal do to avoid such situations in future?
2. Is there a way to keep such fluctuation in power demand under control?

Define: As students delve into a discussion to find a solution for the problem above, the facilitator manoeuvres the discussion towards developing an efficient and smart system to inform users about real-time efficiency and malfunctions.

Ideate: Students think of ways by which users could be notified of a fault occurring in devices due to an obstructed motor, so that on-time remedy can be done.

Prototype: Use Artificial Intelligence with the circuit created before that can identify faults in a machine and notify the user. Here are the steps:

4.1 Save the data incoming from the current sensor in a CSV file with the following Python code:

```
import serial

arduino_port = "COM5" #serial port of Arduino
```

```
baud = 9600 #arduino uno runs at 9600 baud
fileName="sensor-data.csv" #name of the CSV file generated
ser = serial.Serial(arduino_port, baud)
print("Connected to Arduino port:" + arduino_port)
file = open(fileName, "a")
print("Created file")
samples = 10 #how many samples to collect
print_labels = False
line = 0 #start at 0 because our header is 0 (not real data)
while line <= samples:
  # incoming = ser.read(9999)
  # if len(incoming) > 0:
  if print_labels:
    if line==0:
      print("Printing Column Headers")
    else:
      print("Line " + str(line) + ": writing...")
  getData=str(ser.readline())
  data=getData[2:][:3]
  data=data.strip("\n")
  print(data)

  file = open(fileName, "a")
  file.write(data + "\n") #write data with a newline
  line = line+1

print("Data collection complete!")
file.close()
```

4.2 Write a separate code to organise the incoming data in an understandable format with the help of the Pandas Library. Name it analysis.py

```
import pandas as pd

#reading csv file
data=pd.read_csv('sensor-data.csv')

#shape of dataset
print("Shape", data.shape)

#column names
print("\nFeatures: ", data.columns)

#storing the feature matrix (x) and response matrix (y)
x=data[data.columns[:-1]]
y=data[data.columns[-1]]

#printing first 5 rows of feature matrix
print("\nFeature Matrix:\n",x.head())
```

```
#printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

4.3 Now, see how the current reading incoming from the sensor changes once a fault occurs. To induce a fault in the fan, try any of the following methods:

- Use a piece of cardboard as an obstacle to stop the fan attached to the motor and capture the readings
- Stop the power supply of the motor randomly to create fluctuation in current consumption
- Bring a magnet close to the motor to create current fluctuation

4.4 The current readings may fluctuate due to the fault induced. Once the fault is removed, the current readings change again.

4.5 Open the CSV file that has been created for the current sensor values and add another column 'Label' to it. Under this column, put 0 if there was no fault and 1 if the fault was present. the table might look like this:

Current Reading	Label
0.8	0
0.8	0
1.2	1
1.3	1
1.2	1
0.8	0

Here: 0 = No fault detected & 1 = Fault detected

4.6 After manually labelling the data in the previous step, the next step is to create a model which can predict a fault in the motor based on its current reading. From the SciKitLearn package, we use the K-Nearest Neighbour classifier

```
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(x,y)
```

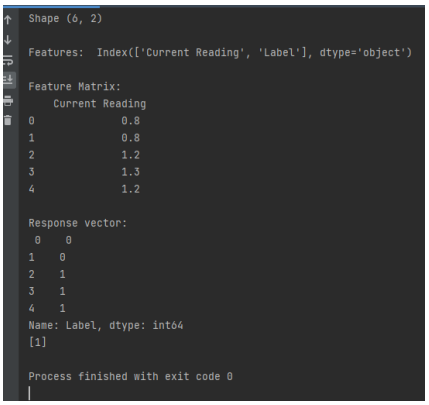
4.7 Once the model is trained, the next step is to check whether the model is working correctly or not. This can be done by real-time testing of the current values received from the motor and passed through the trained model to check for the output. Here we are testing for 1 amp and 25 degrees Celsius temperature (taken as a default)

```
predicted = knn.predict([[1,25]]) #manually input the values from
arduino in the arguments of the knn.predict()
print(predicted)
```

4.8 This is what the whole code looks like when it works together

```
import pandas as pd
from sklearn.neighbors import KNeighborsClassifier
#reading csv file
data=pd.read_csv('current.csv')

#shape of dataset
print('Shape',data.shape)
#column names
print('\nFeatures: ', data.columns)

#storing the feature matrix (x) and response matrix (y)
x=data[data.columns[:-1]]
y=data[data.columns[-1]]

#printing first 5 rows of feature matrix
print('\nFeature Matrix:\n',x.head())

#printing first 5 values of response vector
print('\nResponse vector:\n', y.head())

knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(x,y)

predicted= knn.predict([[1.2]]) #manually input the values from
the arduino in the arguments of the knn.predict()
print(predicted)
```

4.9 And this is the output of the code when it works:



As you can see, when we run the code with current reading as 1.2, the output is 1, which means that a fault is detected by the program.

Learning Outcomes	Learners will be able to: ● learn how to handle ATL tools properly. ● measure physical quantities such as current, power etc. using appropriate apparatus, instruments, and devices. ● correlate electricity bill with power consumption. ● understand the applicability of the concepts of electricity – current flow, electricity fluctuations, electricity consumption, circuit building and ohm's law. ● understand the practical application of sensors and microcontrollers.

	• build an AI model to predict current fluctuations and faults in a circuit. • combine their knowledge around electricity with electronics and AI to create their own project.
Glossary	• Pandas: Pandas is an open-source Python package that is most widely used for data science/data analysis and machine learning tasks. • Modeling is the process of training the model on the available dataset in order to get a prediction when provided with an input. • ACS712 Current Sensor: ACS712 is a Hall Effect-Based Linear Current Sensor that can measure both DC(Direct Current) and AC(Alternating Current). The sensor chip is made by Allegro. • Arduino UNO: is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins. • CSV: A comma-separated values (CSV) file is a delimited text file that uses a comma to separate values. Each line of the file is a data record. Each record consists of one or more fields, separated by commas.
Reference Links:	How to use the ACS712 current sensor: https://www.engineersgarage.com/acs712-current-sensor-with-arduino/
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern Recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability **AI domain** • AI for Data and Computer Vision **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Persuasion • Creative mindset **Interpersonal skill** • Empathy Collaboration

Class 10
Lesson 10.2
Sustainable Management of Natural Resources- Chapter 16

Parameters	Description	Note for teachers
Chapter Covered	Chapter 16: Sustainable Management of Natural Resources	This Lesson Plan must be taken when teaching 'Section:16.3 – Water for All, from Chapter 16: Sustainable management of natural resources, NCERT, Science Textbook of Class X
Name of the Book	NCERT, Science Textbook for Class X	
Learning Objectives	This chapter promotes the awareness around conserving natural resources, and implementing the three R's principle. In this chapter, one of the most prime topics discussed is on preventing water wastage. To enable learners to: **Scholastic:** **Stage 1: Conceptualization** ● Connect the issue of water pollution and water wastage ● Understand the severity of water wastage ● Come up with solutions to reduce water wastage **AI + Tinkering:** **Stage 2 : Contextualization by applying Design Thinking framework** ● Identify the problem in the given scenario ● Come up with ideas to develop a water saving tap, that promotes no-contact **Stage 3: Developing an automatic tap** ● Use IR sensor to trigger the switching of the pump ● Program an arduino unit to automate switching of the pump ● Optimize the sensitivity of IR sensor **Stage 4: Developing a Smart water dispensing system** ● Understand how to control a microcontroller using python	

	• Understand how to train and utilize an image recognition-based ML algorithm. • Create an automated tap that operates on hand-gestures	
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 • Whiteboard & Marker • Computers with Webcam • Good internet connectivity • Arduino UNO • IR sensor • Jumper wires • Relay • Pump motor • 12V DC Adapter • Arduino Power Adapter • Arduino connector cable	
Pre – Preparation Activities	**Scholastic:** • Teacher to keep the following resources ready before the session: 3R's principle https://www.youtube.com/watch?v=f6fLnG71V2Q&ab_channel=PopulationEducation • Explore the following platform before execution Machine Learning for Kids www.machinelearningforkids.co.uk • Teacher may also explore the following resources: Case study on pollution of the sacred river 'Noyyal' https://www.youtube.com/watch?v=kaHmxZhea3M&ab_channel=DWPlanetA	
Previous Knowledge	**Scholastic:** The learner understands the concept of • water pollution • water pollutants **Tinkering:** The learner is familiar with: • Python programming and installing libraries. • Arduino and how to upload programs to a microcontroller	
Methodology	**Stage 1: Conceptualization Scholastic: (Science Teacher)** Teacher engages the learners into a discussion based on the given points: • How water pollution poses threat to sustenance of life, and why water gets polluted in the first place (Hint: Water is abundant on planet earth, Water is a universal solvent)	

The teacher can prepare a powerpoint presentation that sums the various ways how water gets polluted

- Access to hygienic and potable water is just 3% to the total water.
- There is no alternative to water.
- Alternate ways to combat water pollution, caused by dumping waste effluents in rivers by industries such as textile industry.
- Household water consumption and wastage of water.
- 3 R's principle
  https://www.youtube.com/watch?v=f6fLnG71V2Q&ab_channel=PopulationEducation

Contextualization:
AI and Tinkering:
Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario and making IR-based water dispensing system (Subject Teacher & ATL In charge)

Problem Statement/Scenario:

Manu, lives in a joint family of 15 members in a farmhouse, located at a small village in Kerala. The family depends on the dairy farming and floriculture for their livelihood. Manu's father looks after the finances of the family business. While helping his father with the bills, Manu noticed the water bill indicating increased water consumption over the months. So, he started assessing the water consumption daily. It was noticed that a significant amount of water gets wasted when applying soap on hands or while brushing the teeth. Many times, children did not close the tap properly, which led to water wastage by dripping for hours. He also realized that sometimes his clients/customers were using the taps installed on his farm, and he got apprehensive about letting them do so, with the soaring second wave of COVID-19 infections.

Empathize: Ask learners to reflect on the given scenario based on the following points:

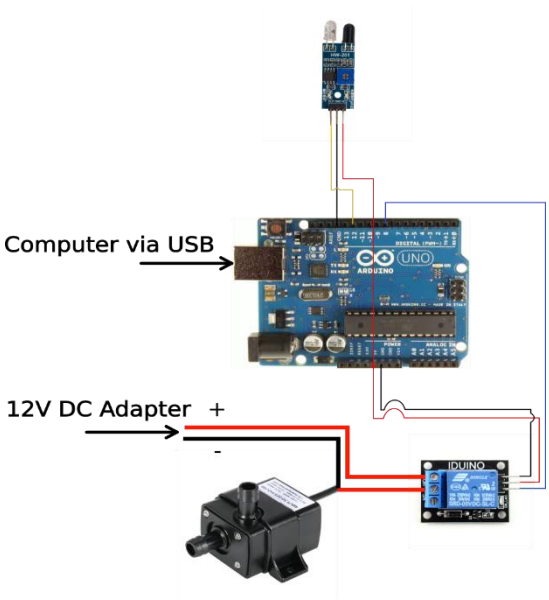
1. Who must be the head of Manu's family?
2. What crops must Manu's family be growing on their farms? (Hint: fodder for cattle and flowers)
3. Is Manu's family educated?
4. Does Manu have a scientific temperament?
5. Is the water used during bathing and washing hands, unhygienic?
6. Do you have any tap at your own home that keeps dripping all day long, no matter how tight you close it?

Define: Ask learners to identify the problem in the given scenario (Hint: The need for an efficient system that saves water from being wasted and promotes no-contact)

Ideate: Learners then delve into developing an automatic tap that turns on by sensing a hand under it

Stage 3: Developing an automatic tap (Subject Teacher & ATL In charge)

3.1 Make the circuit using the following schematic

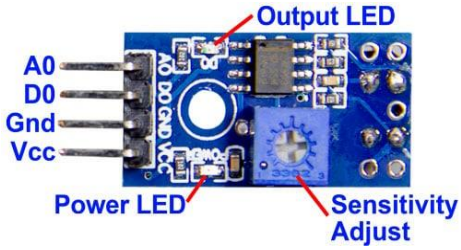


3.2 Here is the Arduino code to test the circuit:

```
void setup() {
 pinMode(12, INPUT); //For the IR sensor
 pinMode(8, OUTPUT); //For the Relay Module
}

void loop() {
 int senseObs = digitalRead(12);

 if (senseObs == 1) {     //If the sensor detects something
  digitalWrite(8, HIGH);  //Turn the pump on

  delay(20000);        //Wait for 10 seconds

  digitalWrite(8, LOW);   //Turn the pump off

 }

 else {

  digitalWrite(8, LOW);   //keep the pump off when nothing is
detected

 }

 delay(100); //To avoid noisy readings

}
```

3.3 After uploading the code to the Arduino board, put your hand in front of the sensor. Once detected, it should turn on the pump for 10 seconds.

3.4 You can also adjust the sensitivity of the sensor by using the potentiometer on the sensor.



3.5 After testing, power the relay using the adapter. Now, the pump will turn on every time you bring your hand close to the sensor.

Stage 4: Developing a Smart water dispensing system (Subject Teacher & AI Faculty)

Initially, Manu was very happy with the installation of the automatic water dispensing system at his farm. However, as time passed, he realized that the IR sensor failed many times, to switch ON when a hand was brought in its proximity, or sometimes accidentally turned ON when someone walked past it. So, he called up the customer service of the automated water dispensing company and got his problem registered. The customer service guy connected his call with the company's R&D unit.

Empathize: Ask learners to reflect on the given scenario based on the following points:

1. What were the limitations of the existing IR-based tap system, as per Manu?
2. Do you think that the customer service was of any help to Manu?
3. What is an R&D unit, and why was Manu connected with it?

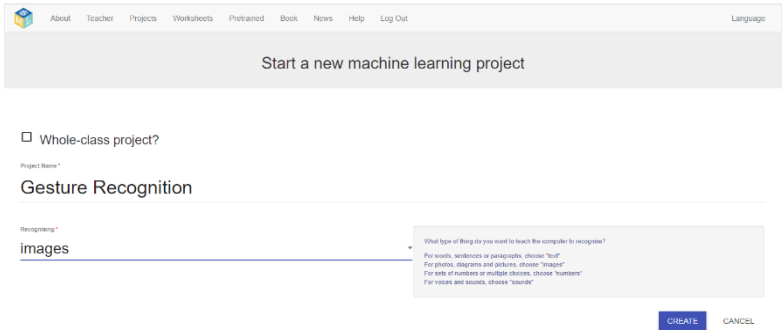
Define: Ask learners to identify the problem in the given scenario and help them brainstorm solutions for the same.

Ideate: Learners can develop an AI model for automated water dispensing, that gets activated for specific intervals when triggered with certain hand gestures, thereby reducing water wastage.

Prototype:

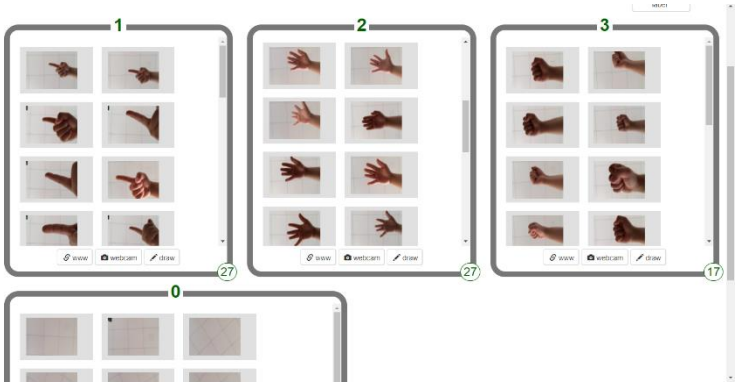
4.1Visit https://machinelearningforkids.co.uk

4.2Create a new project called 'Gesture recognition' and select **images** in the **recognizing** section.



4.3Now, go to the **Train** section and create four different labels - 0,1, 2 and 3. These labels will contain the information of hand gestures.

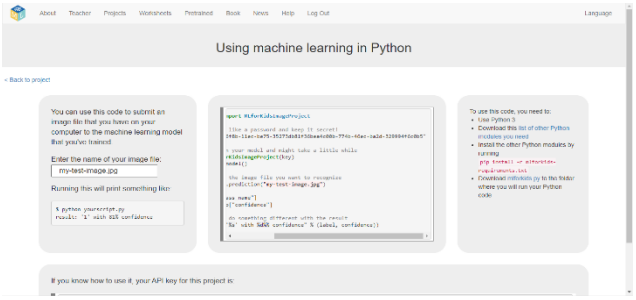
4.4Now, click images of hand gestures to be uploaded under 1, 2 and 3 labels. Put blank background images under label 0. Upload at least 10 images under each label.



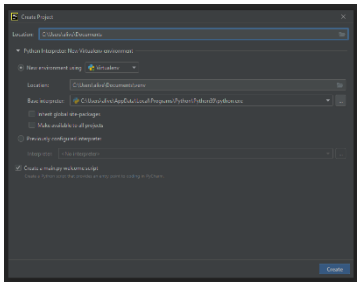
4.5Now, train the model under **Learn and Test** section. Click on **Train new machine learning model** button to start the process. After a few seconds, the model will be trained and ready to use.

4.6After the model is done training, try the model by using a hand gesture and observe the result.

4.7Go to the **Make** section of your AI Project.



4.8Now, open your Python IDE and create a new project. (NOTE: Steps mentioned here are for PyCharm. They may vary according to the Python IDE used)



4.9After creating the project, create a New Python file, and copy the code that you got from the Make section of your AI project.

```
from mlforkids import MLforKidsImageProject

# treat this key like a password and keep it secret!
key = "Insert-API-Key"
```

```
# this will train your model and might take a little while
myproject = MLforKidsImageProject(key)
myproject.train_model()

# CHANGE THIS to the image file you want to recognize
demo = myproject.prediction("my-test-image.jpg")

label = demo["class_name"]
confidence = demo["confidence"]


# CHANGE THIS to do something different with the result

print ("result: '%s' with %d%% confidence" % (label, confidence))
```

4.10 Download **mlforkids-requirements.txt** and **mlforkids.py** from your AI project and save them in the same folder as your python code.

4.11Then, in PyCharm, click on the **Terminal** tab from the bottom of the screen and run the following command to install necessary libraries:

```
pip install -r mlforkids-requirements.txt
```

4.12 Now, go to **Python Packages** tab and in the **search bar**, look for **opencv-python** and **pyserial**. Install both packages.

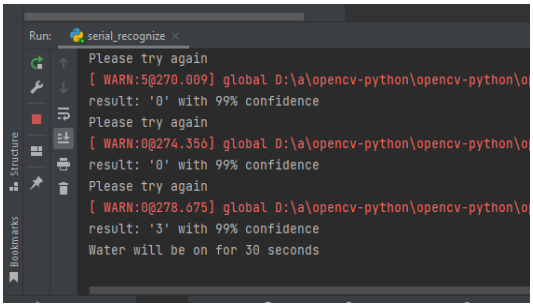
4.13 Here is the final python code:

```
import cv2
import time
import serial
arduino = serial.Serial(port='COM5', baudrate=115200, timeout=.1)
# treat this key like a password and keep it secret!
from mlforkids import MLforKidsImageProject
key = "3bcfbc90-6f8b-11ec-be75-35273db81f36bea4c00b-774b-
46ec-ba2d-329994f6c0b5"
# this will train your model and might take a little while
myproject = MLforKidsImageProject(key)
myproject.train_model()
while True:
  videoCaptureObject = cv2.VideoCapture(0)
  result = 0
  while(result<2):
    time.sleep(2)
    ret,frame = videoCaptureObject.read()
    cv2.imwrite("my-test-image.jpg",frame)
    result += 1
  videoCaptureObject.release()
  cv2.destroyAllWindows()
  # CHANGE THIS to the image file you want to recognize
  demo = myproject.prediction("my-test-image.jpg")
  label = demo["class_name"]
```

```
  confidence = demo["confidence"]
  # CHANGE THIS to do something different with the result
  print ("result: '%s' with %d%% confidence" % (label, confidence))
  if label=="1" and confidence>=70 :
    arduino.write(bytes("1", 'utf-8'))
    print("Water will be on for 10 seconds")
  elif label=="2" and confidence>=70:

    arduino.write(bytes("2", 'utf-8'))

    print("Water will be on for 20 seconds")
  elif label=="3" and confidence>=70:
    arduino.write(bytes("3", 'utf-8'))
    print("Water will be on for 30 seconds")
  elif label=="0":
    arduino.write(bytes("0", 'utf-8'))
    print("Please try again")
```

4.14Now, upload the following code to the Arduino:

```
int pump=8;
void setup() {
 pinMode(pump, OUTPUT);
 digitalWrite(pump, LOW);
 Serial.begin(115200);
}
void loop() {
 // put your main code here, to run repeatedly:
 switch (Serial.read()) {
  case '0':
   digitalWrite(pump, LOW);
   break;
  case '1':
   digitalWrite(pump, HIGH);
   delay(10000);
   digitalWrite(pump, LOW);
   break;
  case '2':
   digitalWrite(pump, HIGH);
   delay(20000);
   digitalWrite(pump, LOW);
   break;
  case '3':
   digitalWrite(pump, HIGH);
   delay(30000);
   digitalWrite(pump, LOW);
   break;
 }
}
```

	4.15Now, connect the Arduino circuit and the webcam to the computer. This is the output that we can see in the Python code: 
Learning Outcomes	Learners will be able to • plan and conduct investigations to analyze water consumption at his/her home. • draw mind maps to track the fate of water once used at home. • exhibits creativity in designing models. • makes efforts to conserve water. • Create an AI model that can distinguish between hand gestures. • Use Python to control outputs of an Arduino.
Glossary	• 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. • 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 recognise text, numbers, images, or sounds. • Arduino UNO: is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins. • Infrared sensor: An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detect motion. • Mounting Hole: Mounting holes let you mount your PCB to an enclosure or a surface. • Grabcad: GrabCAD is the largest online community of professional engineers, designers, manufacturers, and STEM students on the planet. We offer three 3D printing software applications to aid in your designs and 3D printing workflow. • OpenCV: OpenCV (Open Source Computer Vision Library) is an open-source computer vision and machine learning software library.
Reference Links	• Oil Spill Pollution https://www.noaa.gov/education/resource-collections/ocean-coasts/oil-spills • Fecal Pollution https://www.ncbi.nlm.nih.gov/books/NBK572627/ • Nutrient Pollution https://jhcleanwater.org/issues/nutrient-pollution/ • Greywater and its recycling https://en.wikipedia.org/wiki/Greywater • Case-study: How a house in the Netherlands became an energy-efficient one https://www.youtube.com/watch?v=BZns2w3ZqAA&ab_channel=EnergyObserver • SMART Goals https://goalsetting.org/smart-goals

	• A comprehensive guide on PyCharm https://www.jetbrains.com/help/pycharm/creating-and-running-your-first-python-project.html
Skill outcomes	**Tech skill** • Digital learning • Algorithmic thinking • Data gathering • Pattern Recognition • Model optimization **Design thinking** • Ideation • Prototyping **Mathematical and quantitative skills** • Probability **AI domain** • AI for Computer Vision **Physical computing** • Basic electrical and electronics. • Circuit building Knowledge of sensory network **Social impact solution building** • Problem identifying • Problem scoping • Problem solving • Prototyping the AI and tinkering solution **Intrapersonal skill** • Observation skill • Persuasion • Creative mindset **Interpersonal skill** • Empathy • Collaboration **Computational Thinking** • C programming (Arduino)

Class 10

Lesson 10.3

Consumer Rights- Chapter 5

Parameters	Description	Note for teachers
Chapter Covered	Chapter 5: CONSUMER RIGHTS	
Name of the Book	NCERT, Social Science Textbook for Class X	
Learning Objectives	Consumer awareness is the understanding and information about the goods that consumers purchase. What safeguards should consumers have while making product purchases? The five consumer rights are examined in this lesson plan using an educational session. These ideas will be further discussed in class and through activities with the students. Students will be able to explain the background of consumer rights after this session. Moreover, describe the laws and legal actions that support consumer protection. To enable learners to **Stage 1: Conceptualization Scholastic:** ● Understand how people might be exploited in various ways in the market and the steps taken by consumer groups to safeguard themselves. ● Comprehend and explain the Consumer Protection Act, 1986. ● Understand different consumer rights: ➢ Right to safety ➢ Right to be informed ➢ Right to choose ➢ Right to consumer education ➢ Right to seek redressal ➢ Right to representation **AI and Tinkering:** **Stage 2 : Apply Design Thinking** ● Understand how people might be exploited in various ways in the market and the steps taken by consumer groups to safeguard themselves. ● Understand the applicability of the concepts of Consumer Rights and build solutions to provide milk health monitoring. **Stage 3: Developing a ph sensor** ● Understand different consumer rights: ➢ Right to safety ➢ Right to be informed ➢ Right to choose ● Observe and infer the working of ph and Salinity sensors. **Stage 4: Making the AI enabled software** ● Develop algorithms to use microcontrollers with sensors. **Stage 5: Making complex Modeling technique** ● Understand different consumer rights:	teacher can prepare some case study situation ans survey questionnaire to make students aware about consumer exploitation. ppt can be prepared and shown to students to elaborate the topic further.

	➢ Right to consumer education ➢ Right to seek redressal ➢ Right to representation • Build an AI model to predict purity of milk. • Integrate their knowledge of sensor technology with electronics and AI to create their own project.	
Time Required	7 periods of 45 minutes each	
Classroom/ATL Arrangement	Seating arrangement - • Theory Sessions – Regular classroom arrangement • Activity Sessions – Flexible (for group / pair work)	
Material Required	**Scholastic:** • Textbook • Smart Board / screen and projector • Pen and paper • Laptop or smart phone • White board and marker **AI and Tinkering:** • Analog pH sensor • Arduino Uno • Wires	
Pre – Preparation Activities	**Scholastic:** The teacher makes the students observe the posters and cartoons in this chapter and makes them reflect on any particular commodity and the aspects that need to be looked into as a consumer. The learners design a poster for this, covering all the aspects understood through reflection. NOTe:- survey can be conducted to make students aware of consumer exploitation and impact of consumer awareness programs. **AI and Tinkering:** 1. Different samples of milk from different sources such as pure milk, diluted milk. 2. Google collaborator set up https://www.youtube.com/watch?v=i-HnvsehuSw&t=317s	students can be asked to collect details about Jago Grahak Jago" program
Previous Knowledge	**Scholastic:** The teacher initiates a whole class discussion through the following prompts: 1. What are the various ways by which people may be exploited in the market? 2. Think of one example from your experience where you thought that there was some 'cheating' in the market. 3. What do you think should be the role of the government to protect consumers?	

	The discussion helps the learners understand: ● Various ways by which people may be exploited: ➢ product weighed less than it should be. ➢ price manipulation. ➢ adulteration. ➢ defective goods. ➢ rampant food shortage, hoarding, black marketing. ● The consumer movement as a 'social force' originated with the necessity of protecting and promoting the interests of consumers against unethical and unfair trade practices. ● The reason for the major step taken in 1986 by the Indian government for the enactment of Consumer Protection Act 1986, popularly known as COPRA. **AI and Tinkering:** Basic knowledge of the following would be needed: ● Programming an Arduino UNO Board. ● Sensor connections and usage. ● Python Packages: MatPlotLib and Pandas. ● AI Modeling in Python. ● **Understand the working of Arduino and the basics of AI.** https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s https://www.youtube.com/watch?v=2ePf9rue1Ao ● **Understand the basics of python and its packages.** https://aistudent.community/single_course/2021 ● **Understanding of Modeling techniques in AI.** https://youtu.be/7ZoQt2XlykY ● **Understand the basics of neural networks.** https://towardsdatascience.com/a-gentle-introduction-to-neural-networks-series-part-1-2b90b87795bc https://youtu.be/7ZoQt2XlykY ● **Basics of evaluation of AI Models.** https://youtu.be/7ZoQt2XlykY	
Methodology	**Stage 1: Conceptualization Scholastic: (Social Science Teacher)** The teacher leads the learners into the understanding of the rights of consumers. **Activity 1** The learners list the safety rules to be observed by the producer for the following products/services. ➢ LPG cylinder. ➢ Cinema theatre. ➢ Fuel station. ➢ Medicines. ➢ High-rise building. The teacher engages the learners in a discussion to reflect on any case of accident or negligence on part of people around them, where they think that the responsibility lies with the producer. **Activity 2**	

- Teacher asks the learners to bring a few packaged goods available at home or that they can buy. The learners examine the information given on them. They discuss in their groups how this information will be useful.
- Teacher asks the learners to analyse the information given on the package and discuss and list down the points that they think may not have been covered.
- A member from each group shares their observations with the class.

Activity 3

Teacher initiates a discussion on buying behaviour of people, when they go shopping. The learners reflect on the situation : Is the choice among products available to them or are they forced to buy one product by the seller?

With the help of the above three activities, the teacher encourages the learners to reflect on understanding different rights of consumers.

Contextualization:

AI and Tinkering:

Stage 2 : Apply Design Thinking framework *(refer to chapter 2.1 for details on Design thinking Framework)* on the given scenario (Subject Teacher & ATL in-charge)

Problem Statement/Scenario: *On Sundays, as a routine, Riya's entire family gets engaged in household work to help her mother. While Riya is helping her mother in the kitchen preparing 'Kheer', a sweet dish, her mother tells her that these days milk quality is not the same as it used to be. She further adds that she has complained about the same to the milkman, but he does not agree to the fact.*

Empathize: : Students are asked to brainstorm on the above scenario and they are made to think deeper about it by asking the following questions

1. Which dishes require milk as an ingredient?
2. If the milk quality is not good what do you think will be the consequences?
3. Have you ever heard anyone talking about low-quality milk or any other product?
4. What actions do you think they take to address the problem?
5. Why do you think when Riya's mother complained to the milkman, she was not able to find a solution?
6. Do you feel we have a right to get quality products?

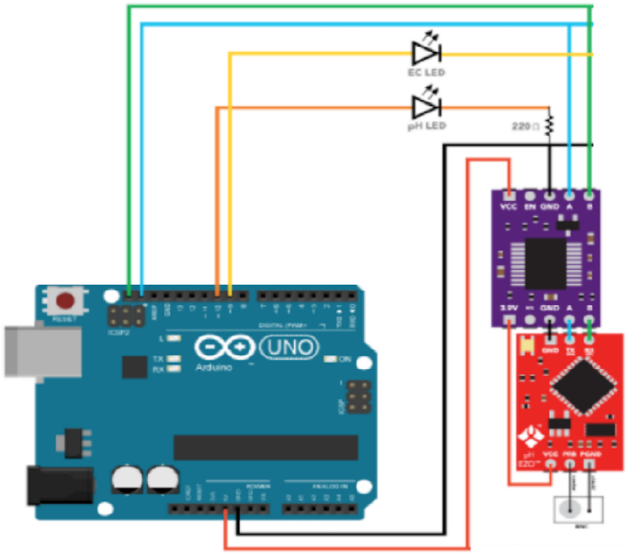
Define: Have you witnessed such a situation at your home or nearby? Can you think of some solution to solve this problem?

Ideate: Students will now be asked to come up with different alternatives to check or detect the quality of product (Milk).

Stage 3: Developing a pH sensor to check the purity of milk (Subject Teacher and ATL - Incharge)

3.1 **Making the Hardware:** Using the following circuit diagram students will make the hardware.

Circuit Diagram:



3.2 **Algorithm**

After connecting the hardware according to the schematic, the learners make an algorithm on which the programming will be based. Following steps to be followed to understand the key steps and their structure:

- **Data Collection**
  In order to understand the correlation between the pH and the milk purity, data needs to be collected from both the sensors.
  - Define the Pins through which data is collected from Arduino UNO
  - Take Input from Analog pH sensor
  - Store the values in variables
- **Data Processing :** The data collected is in the raw stage and needs to be processed for further understanding and analysis. Process the data received from pH sensor.
- **Data Transfer** :Once the data is processed, it is transferred to the system through serial communication using USB Cable.
  - Send the processed data from Arduino to the system.
  - Store all the processed data to be transferred in a String.
  - Send the data using Serial Communication every time milk is received.

Stage 4: Making the AI enabled software (Subject teacher and AI Faculty)

4.1 Importing data from Hardware

Once the hardware is set up, data is collected from the sensors at regular intervals. The first and foremost step is to store this data. In order to do so, the data is captured from the serial monitor and stored in a csv (comma separated values) file for further usage. The learner notes down the values in the csv by measuring from Arduino.

4.2 Data visualization & Exploration

Once data acquisition part of the AI Project cycle is complete, the next stages are Data Visualization and Exploration.

In this section the learner explores the ways data collected from various sensors and stored in CSV files can be used in order to create an AI model.

In the current example, data collected is current consumption and temperature which is being stored in the form of a csv file at regular intervals of time.

Python packages are now used to visualize the data captured.

```
import pandas as pd

# reading csv file
data = pd.read_csv('file_path')

# shape of dataset
print("Shape:", data.shape)

# column names
print("\nFeatures:", data.columns)

# storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]

# printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())

# printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

After visualising the relation between the pH, the next step is to create a model which can predict the purity of the milk based on the above parameters.

In order to achieve this, a labelled dataset is created to train the model for classifying the purity of milk as per pH.

This can be done by deliberately creating an impure mixture of milk:

- Option 1: Add water to milk to create an impure milk solution.
- Option 2: Use milk powder in milk to understand the other mixture.
- Option 3: Use curd or any other milk derived products to get outliers.

The data captured after following either of the above-mentioned steps is labelled as per the labels: Pure or Impure.

An example of the data is given below.

Stage	pH reading	Label
Pure	2	1
Impure	7	0
Impure	5.5	0
Pure	9	1
Pure	11	1
Impure	4	0

Here,

0 – Impure

1 – Pure

The learner needs to label the data captured in the given format in order to make it ready for training a model.

4.3 Modeling and Evaluation

Once the data is labelled and ready for use, the next step is to train the model, which is done first through the stage Modeling.

In the current project, the example is a classification problem, and using the Scikit learn cheat sheet, the learner uses the SciKitLearn package to train the classification model.

```
[ ] from sklearn.neighbors import KNeighborsClassifier
    knn = KNeighborsClassifier(n_neighbors=3)
    knn.fit(X, y)
```

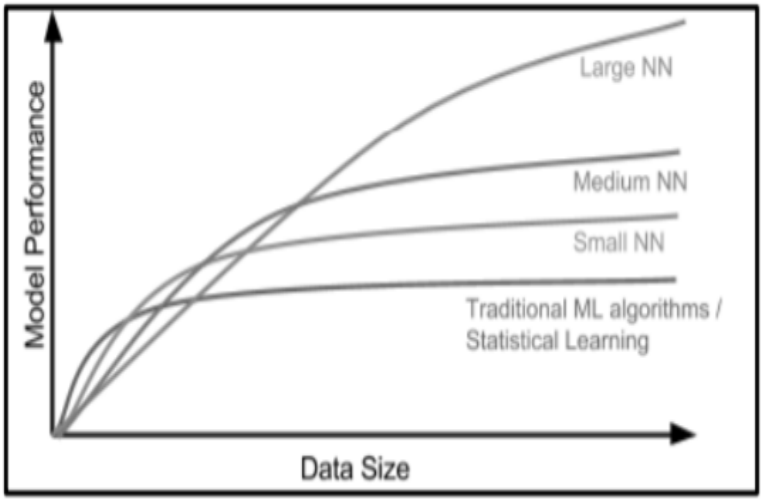
Once the model is trained, the next step is to check whether the model is working correctly or not. This comes under the stage Evaluation of the AI Project Cycle. This can be done by real time testing of the pH values and getting the predictions out of it.

Stage 5: Making complex Modeling technique for AI enabled software (Subject teacher and AI Faculty)

The next step is to try complex Modeling techniques on the same data set and compare the performance of both the models.
In this stage, a neural network is trained using deep learning techniques.
Following is the training of a neural network on the already available labelled data of the ph value of the milk obtained,

5.1 Data Reading

```
mport pandas as pd
 # reading csv file
data = pd.read_csv('/content/Ph data - Sheet1.csv')
# shape of dataset
print("Shape:", data.shape)
 # column names
print("\nFeatures:", data.columns)
 # storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())
 # printing first 5 values of response vector
print("\nResponse vector:\n", y.head())

Model designing and training:
import numpy as np
from tensorflow.python.keras.layers import Input, Dense
from tensorflow.python.keras.models import Model

input1 = Input(shape=(1,))
l1 = Dense(10, activation='relu')(input1)
l2 = Dense(50, activation='relu')(l1)
l3 = Dense(50, activation='relu')(l2)
out = Dense(2)(l3)

model = Model(inputs=input1, outputs=[out])
model.compile(
  optimizer='adam',
  loss=['mean_squared_error']
  )

history = model.fit(X, y, epochs=1000, batch_size=2)
output :
y_predict = model.predict([2])
```

	5.2 Observation: After the model is trained, the prediction of the purity of milk is received using the Neural Network and KNN model. The learner observes the difference in the performance of both the models. The next step is to try and check the performance of the model by increasing the amount of data. This is to observe that the performance of the model varies as per the amount of data used for training a model. The relation between the model performance and data size varies as per the below mentioned graph. 
Learning Outcomes	The learner ● understands various ways of consumer exploitation in the market and steps taken by consumer groups to protect their interest. ● explains the implications of Consumer Protection Act, 1986 specifically with respect to India. ● understands different consumer rights and how these rights can help the consumers in their day to day lives. ● plans and conducts investigations or experiments to arrive at and verify the facts, principles, phenomena or seeks answers to queries on their own. ● relates processes and phenomena with causes and effects, applies scientific concepts in daily life and solving problems. ● applies learning to hypothetical situations.
Glossary	● CSV : Comma separated values ● Pandas: an open-source Python package used for data science/data analysis and machine learning tasks. ● MatplotLib: a plotting library for the Python programming language. ● Data Acquisition: Data Acquisition refers to acquiring authentic data from reliable and authentic sources/ platforms that is required for the AI model. There can be various ways to collect data. ● Data Exploration: Data Exploration refers to visualising the data to determine the pattern, relationships between elements and trends in the dataset that gives a clear meaning and understanding of the dataset. Data exploration is important as it helps the user to select an AI model in the next stage of the AI project cycle. To visualise

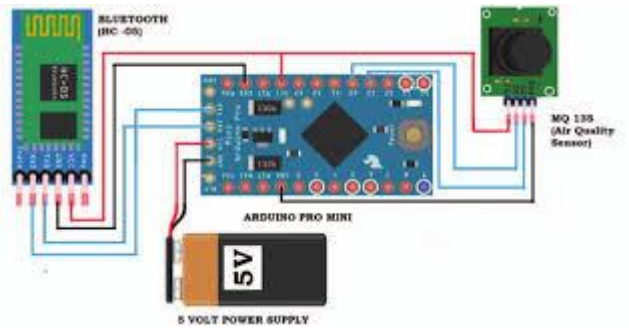
	the data, various types of visual representations can be used such as diagrams, charts, graphs, flows and so on. ● Data Visualization: Data is the fuel of artificial intelligence. A machine is said to be artificially intelligent if it gets trained and can make decisions/ predictions on its own and learns from its own experience and mistakes. In the Modeling stage, data is split to training set and testing set. The model is trained on the training set from which it makes its own rules that helps the machine to give an output and the model is then evaluated on the testing set. ● KNN Model : K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning
Skill outcomes	Tech skill ● Digital learning ● Algorithmic thinking ● Data gathering ● Pattern Recognition ● Model optimization Design thinking ● Ideation ● Prototyping Mathematical and quantitative skills ● Probability AI domain ● AI for Data Physical computing ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network Social impact solution building ● Problem identifying ● Problem scoping ● Problem solving ● Prototyping the AI and tinkering solution Intrapersonal skill ● Observation skill ● Persuasion ● Creative mindset Interpersonal skill ● Empathy ● Collaboration Computational Thinking ● C programming (Arduino)

Class 10
Lesson 10.4
Manufacturing Industries- Chapter 6

Parameters	Description	Note for teachers
Chapter Covered	Chapter 6: Manufacturing Industries	
Name of the Book	NCERT, Social Science, Economics Textbook for Class X	
Learning Objectives	National economy and its growth are based on its manufacturing sector. Students will learn through this lesson the value of manufacturing industries in the development of economies. They will be informed of how the many industries influence the expansion of the national economy. They will also be able to comprehend how industrialization causes environmental deterioration at the same time. Educate students on the significance of environmental contamination. To enable learners to Stage 1: Conceptualization Scholastic: (Social Science Teacher) : ● Appraise the importance of manufacturing industries in their economic growth. ● Understand the contribution of industries to national economic growth. ● Classify the industries on the basis of their use. ● Enlist the factors which influence the location of the industries. ● Analyse the factors responsible for environmental degradation. ● Sensitize themselves towards the impact of environment pollution. AI and Tinkering : Stage 2 : Apply Design Thinking • Analyse the factors responsible for environmental degradation. • Understand the applicability of concepts of AQI and build solution to detect harmful or critical air detection, thereby reducing the factors of it. Stage 3: Making a hardware ● Analyse the factors responsible for environmental degradation. ● Enlist the factors which influence the location of the industries. ● Understand how AQI detection works. ● Develop algorithms to use microcontrollers with AQI sensor. Stage 4: Making AI enabled software ● Build an AI model to predict accuracy of the Air quality. ● Integrate their knowledge of sensor technology with electronics and AI to create their own project.	Teacher can develop an Industrial classification chart based on previous knowledge of class viii same topic. Teacher can also develop an activity kit like play card or word association on factors affecting different industries or how different industry effect environment differently.
Time Required	7 periods of 45 minutes each	
Classroom/ATL Arrangement	Seating arrangement - ● Theory Sessions – regular classroom arrangement ● Activity Sessions – Flexible (for group / pair work)	

Material Required	Scholastic: ● Textbook ● Smart Board / screen and projector ● Pen and paper ● Laptop or smartphone ● White board and marker AI and Tinkering : ● MQ135 sensor ● Arduino Uno ● HC05 module	
Pre – Preparation Activities	Activity: The teacher shows a video to explain the role of industries in economic development https://www.drishtiias.com/loksabha-rajyasabha-discussions/the-big-picture-role-of-industry-in-atma-nirbhar-bharat AI and Tinkering : The teacher makes arrangements of the hardware required. The teacher installs the Blynk app in their mobile phone. Google collaborator set up https://www.youtube.com/watch?v=i-HnvsehuSw&t=317s	A ppt can be develop which focus on different classification ,importance, impact on economy, and employment.
Previous Knowledge	Scholastic: The teacher initiates a discussion with the learners through the following prompts: ● What are the different sectors of economy? ● What are the different types of industries? AI and Tinkering : In order to make the prototype, a basic knowledge of the following would be needed: ● Programming an Arduino UNO Board ● Interfacing of the Blynk App ● Sensor connections and usage ● Python Packages: MatPlotLib and Pandas ● AI Modeling in Python ● Understand the working of Arduino and the basics of AI. https://www.youtube.com/watch?v=nL34zDTPkcs&t=3s https://www.youtube.com/watch?v=2ePf9rue1Ao ● Understanding of the basics of Blynk App https://www.makeuseof.com/tag/getting-started-blynk-simple-diy-iot-devices/ ● Understand the basics of python and its packages https://aistudent.community/single_course/2021 ● Understanding of Modeling techniques in AI https://youtu.be/7ZoQt2XlykY ● Understand the basics of neural networks. https://towardsdatascience.com/a-gentle-introduction-to-neural-networks-series-part-1-2b90b87795bc	

	https://youtu.be/7ZoQt2XlykY ● Basics of evaluation of AI Models. https://youtu.be/7ZoQt2XlykY	
Methodology	Stage 1: Conceptualization Scholastic: (Social Science Teacher) The teacher leads the learners into the understanding of manufacturing industries: Activity 1: Flow Chart The learners will be asked to draw a flow chart to understand the classification of industries. Activity 2: Concept Mapping The learners will be asked to make a concept map to understand the location of industries. A discussion would be initiated to identify various factors affecting choice of industrial location. Activity 3: Debate on the Topic "Should industries be banned in city centres, as these create a lot of pollution?" The teacher will divide the whole group in two parts: one in favour of growth of industries and another against the growth of industries. After the discussion, learners will be able to justify the role of industries in economic development and what measures can be ensured to control environmental degradation and environment pollution. Contextualization: AI and Tinkering: Stage 2 : Apply Design Thinking framework(refer to chapter 2.1 for details on Design thinking Framework) on the given scenario (Subject Teacher & ATL in-charge) Problem Statement/Scenario: Schools had just opened physically after the Corona pandemic eased out. After a week, the government again announced the closure of schools due to high levels of pollution. Vishal and his classmates were very upset about this pollution break, which is announced unexpectedly every year during winters. During their online class, they discussed their concern with their social science teacher. Empathize: The students will now reflect on the scenario: ● Why were Vishal and his classmates excited when the schools reopened? ● Why were schools closed again? ● Was this an issue that occurred every year or was it happening only this year? Define: Can you relate with this problem? Would you like to initiate and give some suggestions by discussing in your groups how you can together find a solution to this problem which is affecting the world at large? Ideate: Students will now be asked to come up with solutions to reflect upon the problem and ensure the quality of air is checked before it reaches toxic levels. Stage 3: Making a hardware to create Air Quality Index monitoring using MQ135 sensor - tinkering (Subject teacher and ATL incharge) 3.1Making the Hardware: Make the hardware using the following Schematics	



The MQ-135 gas sensor senses gases like ammonia nitrogen, oxygen, alcohols, aromatic compounds, sulfide, and smoke

3.2Algorithm:

After connecting the hardware according to the schematic, the next step is to make an algorithm to understand the flow of the program. Following are the key steps to create an algorithm.

Step1: Data Collection

In order to understand the ambient air and the AQI, there is a need to collect the data from the AQI sensor.

- Defining the Pins through which data will be collected from Arduino UNO.
- Input is taken from TCS3200 sensor.
- The values are stored in variables.

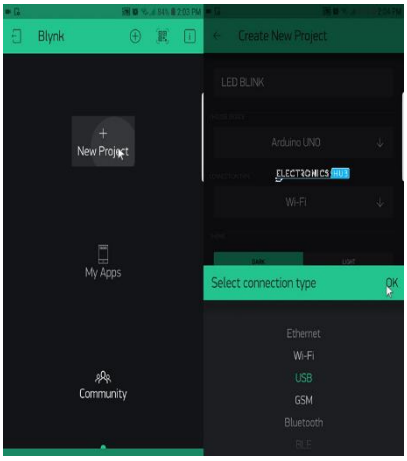
Step 2: Data Processing

The data that is received from the sensors is raw in its stage, and there is a need to process them to make it ready for training. Data received is processed through AQI sensor.

Step 3: Data Transfer

Finally, after processing the data, the data is transferred to the system through serial communication using USB Cable and is sent from Arduino to the system.

- All the processed data to be transferred is stored in a String.
- The data is sent using Serial Communication by reading the sensor data.

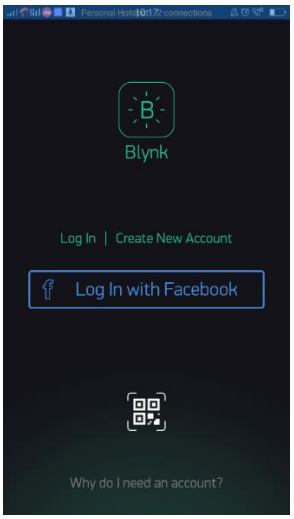


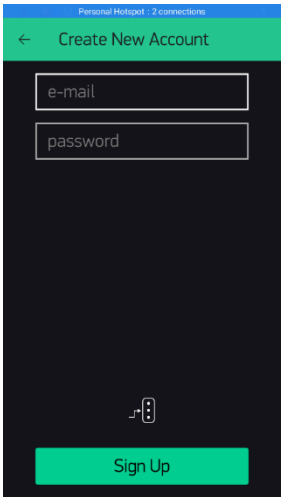
Step 4: Write the below mentioned code in the Arduino IDE and upload it to start getting values from the sensor and also configure the blynk app for output in the mobile app.

```
#include <SoftwareSerial.h>
SoftwareSerial DebugSerial(2, 3); // RX, TX
char auth[] = "Your Auth.";
int sensorValue;
int digitalValue;
void setup()
{

Serial.begin(9600); // sets the serial port to 9600
pinMode(13, OUTPUT);
pinMode( 3, INPUT);
 Blynk.begin(Serial, auth);
}

void loop()
{
sensorValue = analogRead(0); // read analog input pin 0
Blynk.virtualWrite(V1, sensorValue);
digitalValue = digitalRead(2);
if(sensorValue>400)
{
digitalWrite(13, HIGH);
}
else
digitalWrite(13, LOW);
Serial.println(sensorValue, DEC); // prints the value read
Serial.println(digitalValue, DEC);
delay(1000); // wait 100ms for next reading
}
```

Step 5: Once the code has been uploaded follow the steps given below to start receiving values from the sensor and show as an output on mobile phone.

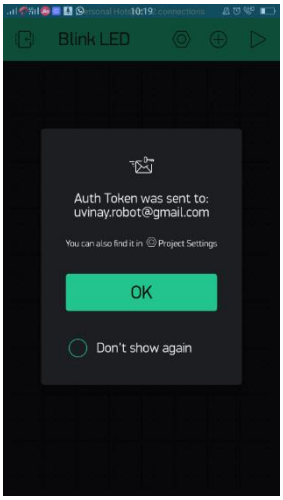
- Download the “Blynk” app from playstore/appstore.
- Setup the Blynk app by logging the credentials.



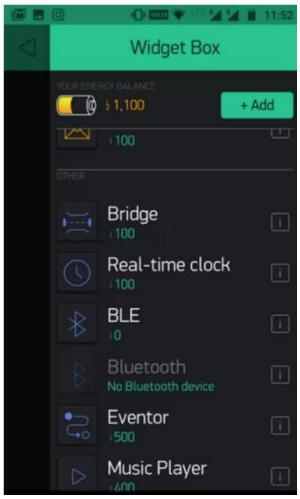


Step 6: After setting up click on new project and add the Bluetooth as device from the device list.

Step 7: After adding device, the token will be generated which you will need to add it in the code.

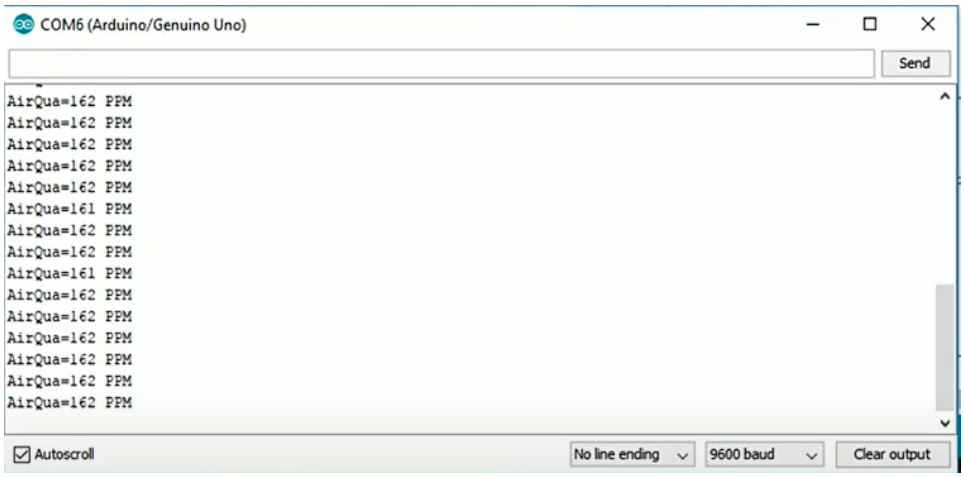


Step 8:From the widgetbox click on Bluetooth and select Gauge to show the output.



Step 9: The output window will look as given below once the gauge is selected and pin “V1” is selected.

Step 10: Now that the data from the sensor is flowing, the next step is to figure out how this data can be used to solve the problem. Once the code has been uploaded, the same data can also be viewed at the serial monitor. A sample snippet is mentioned below for reference:



Now that the data from the sensor is flowing, the next step is to figure out how this data can be used to solve the problem.

Stage 4: Making AI enabled software (Subject teacher and AI Faculty)

4.1 Importing data from Hardware : Once the hardware is set up, data is collected from the sensors at regular intervals. Now the question arises, what will we do with this data? The first and the foremost step is to store this data. In order to do so, the data must be captured from the serial monitor and stored in a csv (comma separated values) file for further usage. The values in the csv will be noted by measuring from the arduino.

4.2 Data visualization & Exploration : Once the data acquisition part of the AI Project cycle is done, the next stages are Data Visualization and Exploration.

In this section the learners will explore the ways the data collected from various sensors and stored in a CSV file can be used in order to create an AI model.

In the current example, data collected is analog Air quality measurements, which is being stored in the form of a csv file at regular intervals of time.

Let us now use python packages to visualize the data captured.

import pandas as pd

```
# reading csv file
data = pd.read_csv('file_path')
# shape of dataset
print("Shape:", data.shape)
# column names
print("\nFeatures:", data.columns)
# storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]
# printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())

# printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

As visualized, the relation is between the gas and AQI index, the next step is to create a model which can predict the air quality based on the above parameters.
In order to achieve this, there is a need to create a labelled dataset which can be used to train the model for classifying analog readings as per the AQI data.
This can be done by deliberately using different gases or environments:

- Option 1: Generate Smoke using Paper / matchsticks.
- Option 2: Generate Smoke using Leaves.

The data captured after following either of the above-mentioned steps needs to be labelled as per the labels: Critical / Moderate / Good. An example of the data is given below.

Stage	AQI data	Label
Good AQI	121	1
Moderate AQI	199	1
Critical AQI	237	0

Here,
0 – Good / Moderate AQI
1 – Critical AQI
The data captured needs to be labelled in this manner in order to make it ready for training a model.

4.3 Modeling & Evaluation: Once the data is labelled and ready for use, the next step is to train the model. In the current project, the example is a classification problem, and using the Scikit learn cheat sheet, the learner will use the SciKitLearn package to train the classification model.

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(X, y)
output = knn.predict([[200]])
```

Once the model is trained, the next step is to check whether the model is working correctly or not. This comes under the stage evaluation of the AI Project Cycle.
This can be done by real time scanning the fruit color and getting the predictions out of it.

Stage 5: Making complex Modeling technique for AI enabled software (Subject teacher and AI Faculty)

The next step is to try complex Modeling techniques on the same data set and compare the performance of both the models.
In this stage, the learner will work around training a neural network using deep learning techniques.
Given below is a training of neural networks on the already available labelled data for the AQI readings from the sensor.

5.1 Data Reading

```
import pandas as pd
 # reading csv file
data = pd.read_csv('/content/AQI_readings - Sheet1.csv')
# shape of dataset
print("Shape:", data.shape)
 # column names
print("\nFeatures:", data.columns)
 # storing the feature matrix (X) and response vector (y)
X = data[data.columns[:-1]]
y = data[data.columns[-1]]
 # printing first 5 rows of feature matrix
print("\nFeature matrix:\n", X.head())
 # printing first 5 values of response vector
print("\nResponse vector:\n", y.head())
```

5.2 Model designing and training:

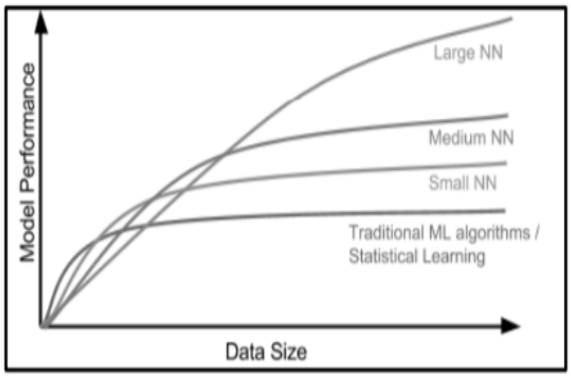
```
import numpy as np
from tensorflow.python.keras.layers import Input, Dense
from tensorflow.python.keras.models import Model

input1 = Input(shape=(1,))
l1 = Dense(10, activation='relu')(input1)
l2 = Dense(50, activation='relu')(l1)
l3 = Dense(50, activation='relu')(l2)
out = Dense(2)(l3)

model = Model(inputs=input1, outputs=[out])
model.compile(
  optimizer='adam',
  loss=['mean_squared_error']
  )

history = model.fit(X, y, epochs=1000, batch_size=2)
```

5.3 Output :

```
y_predict = model.predict([2])
```

5.4 Observation:

After the model is trained, the prediction of air quality is received using the Neural Network and KNN model.

	It is observed that the performance of both the models is different. The next step is to try and check the performance of the model by increasing the amount of data. This is to observe that the performance of the model will vary as per the amount of data used for training a model. The relation between the model performance and data size varies as per the below mentioned graph.  Must Try: One can try changing the dataset size and map it with the performance of the models.
Learning Outcomes	The learner will be able to: ● comprehend the importance of manufacturing industries in their economic growth. ● familiarize themselves with the contribution of industries to the national economy. ● classify the industries on the basis of their use. ● understand the factors which influence the location of the industries. ● analyse the factors responsible for environmental degradation. ● understand the impact of environmental pollution. ● relate processes and phenomena with cause and effects, apply scientific concepts in daily life and solve problems. ● apply learning to hypothetical situations. ● infer how AQI detection works. ● develop algorithms to use microcontrollers with AQI sensor. ● build an AI model to predict accuracy of the Air quality.
Glossary	● IOT: The term IoT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves. ● Blynk App: Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. ● Bluetooth Module HC-05: It is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with a controller or PC.
Skill outcomes	Tech skill ● Digital learning ● Algorithmic thinking ● Data gathering ● Pattern Recognition ● Model optimization

	Design thinking ● Ideation ● Prototyping Mathematical and quantitative skills ● Probability AI domain ● AI for Data Physical computing ● Basic electrical and electronics. ● Circuit building Knowledge of sensory network Social impact solution building ● Problem identifying ● Problem scoping ● Problem solving ● Prototyping the AI and tinkering solution Intrapersonal skill ● Observation skill ● Persuasion ● Creative mindset Interpersonal skill ● Empathy ● Collaboration Computational Thinking ● C programming (Arduino)

Annexures

AIoT Integrated Lesson Plan Evaluation Rubric

S No	Criteria	Excellent 20	Accomplished 15	Acceptable 10	Needs Improvement 5
1	Problem Statement • A well-defined and articulated design problem	A well-contextualized and articulated problem statement provides a better understanding of the problem.	A well-contextualized problem statement provides a good understanding of the problem.	The problem statement connects with real life and provides some understanding of the problem.	The problem statement needs to be contextualized and articulated better.
2	Design Concept • Novel, Creative, and Innovative concept. • Coherency throughout the design process	The design concept is novel, creative, and innovative which perfectly aligns with the design process	The design concept is creative, and innovative and greatly aligns with the design process	The design concept is innovative and aligns with the design process	The design concept is simple and somewhat aligns with the design process
3	Sensors & Electronics • Age Appropriate • Relevance to project/problem statement	The sensors and electronics items used are age – appropriate and align with problem statement needs & requirements.	The sensors and electronics items used are age – appropriate and address problem statement needs & requirements to great extent.	The sensors and electronics items used are age – appropriate and address problem statement needs & requirements to some extent.	The sensors and electronics items used are not age – appropriate.
4	AI Toolsets & Algorithms • Uses Appropriate Algorithms • Use of Age-appropriate AI Tool Set • Use of Project Relevance Ai Toolset	AI Toolsets and algorithms used are age – appropriate and align with problem statement needs & requirements.	AI Toolsets and algorithms used are age – appropriate and address problem statement needs & requirements to great extent.	AI Toolsets and Algorithms used are age – appropriate and address problem statement needs & requirements to some extent.	AI Toolsets and Algorithms used are not age – appropriate.
5	Documentation • Well -articulated Methodology • Well-articulated Learning Outcome • Mapped Skill outcome	• Methodology is self-explanatory • Learning Outcomes are aligned with the concept • Skills outcomes are clearly defined	• Methodology is explanatory • Learning Outcomes are to an extent aligned with the concept • Skills outcomes are defined	• Methodology is somewhat explanatory • Learning Outcomes are somewhat aligned with the concept • Skills are mentioned	• Methodology is incomplete • Learning Outcomes are not aligning with concept • Skills are not mentioned

Repository of Sensors available in the ATL Labs

- Potentiometer
- LDR
- Force Sensitive Sensor
- Flex Sensor
- Air/Water Flow Sensor
- Water Level
- Rain Water Sensor
- Soil Moisture
- MQ series of Gas Sensor
- Barometric Pressure Sensor
- DHT 11 Humidity and Temperature
- Microphone Sensor
- Buzzer
- Ultrasonic Distance Sensor
- IR Sensor
- Pulse Sensor
- PIR Motion Sensor
- Tri color led
- Laser Sensor Module
- 16x2 LCD Screen Shield with buttons
- Capacitive Touch Sensor
- LED & tap switch module
- Hall Current Sensor
- Joystick
- 5V relay module
- Motor Driver Shield
- Small Servo
- DC Motor

For more details on the Sensors please visit this link http://bit.ly/SensorsDescription

Repository of online resources

Brief Description	Resource URL
Design Thinking	https://www.youtube.com/watch?v=a7sEoEvT8l8 https://www.youtube.com/watch?v=qyoZTUGzdGY
Design thinking - IDEO Insights	https://www.youtube.com/watch?v=gPqjKOA1qlo
What is Design Thinking?	https://www.youtube.com/watch?v=Ee4CKIPkIik
How to brainstorm - individually/in a group	https://www.youtube.com/watch?v=aPnTPK0c53w https://www.youtube.com/watch?v=GLpZ6RZHyoM
Complex Systems Design Thinking (How to do it)	https://www.youtube.com/watch?v=WrdSkqRypsg
Five Rules of Design Thinking (TED Talk) (Why and how to do it)	https://www.youtube.com/watch?v=TAV08bn5uEo&t=23s
Design Thinking with Elementary Students (How to do it)	https://www.youtube.com/watch?v=hvqST2ggvA0
Design Thinking - CEO of IDEO (How and why to do it)	https://www.youtube.com/watch?v=U-hzefHdAMk
Design Thinking, What, why and when? (TED Talk)	https://www.youtube.com/watch?v=Q80wUnju5YA&t=1s
The Launch Cycle: Design Thinking Framework for K-12 Students	https://www.youtube.com/watch?v=LhQWrHQwYTk
Design Thinking Animation	https://www.youtube.com/watch?v=uRtAzzitBmA
Computational Thinking and Thinking about Computing	https://www.cs.cmu.edu/afs/cs/usr/wing/www/talks/ct-and-tc-long.pdf
More about Computational Thinking	Computational Thinking (In-depth Explanation) https://www.youtube.com/watch?v=C2Pq4N-iE4I Computational Thinking from code.org https://www.youtube.com/watch?v=injJWiSA0pw Abstraction Computational Thinking https://www.youtube.com/watch?v=jV-7Hy-PF2Q
Know more about Single Board Microcontrollers	https://en.wikipedia.org/wiki/Single-board_microcontroller
All about Circuits	http://www.build-electronic-circuits.com/free-electronic-circuits/ Basic Electricity: Current, Resistance and Ohms Law https://www.youtube.com/watch?v=NfcgA1axPLo Basic Tutorial on Introduction to Circuits by Khan Academy (Tutorial) https://www.youtube.com/watch?v=3o8_EARoMtg There is a course on Circuit Physics by Khan Academy. It's very good for beginners. (Playlist for Circuit Physics Course) https://www.khanacademy.org/science/physics/circuits-topic How to Use Breadboard

	https://www.youtube.com/watch?v=6WReFkfrUIk Paper Circuit (How to do it) https://www.youtube.com/watch?v=BwKQ9Idq9FM
All about Sensors	https://www.electrical4u.com/sensor-types-of-sensor/ https://www.youtube.com/watch?v=q1xNuU7gaAQ
What's an Algorithm?	https://www.youtube.com/watch?v=6hfOvs8pY1k https://www.youtube.com/watch?v=Da5TOXCwLSg
Algorithm in Pseudo Code, Flow Diagrams and Programming	https://www.youtube.com/watch?v=HhBrkpTqzqg https://www.youtube.com/watch?v=XDWw4Ltfy5w
An Overview of Flowchart	https://www.youtube.com/watch?v=uCNliFuKG8I
Real-life Algorithms – Paper Airplanes	https://www.youtube.com/watch?v=AWqo8Gxtrjs
Electronic Components	Simple Guide to Electronics (Tutorial) https://www.youtube.com/watch?v=6Maq5IyHSuc Basics of Coils (Part 1) (Tutorial) https://www.youtube.com/watch?v=kdrP9WbJIb8 Basics of Coils (Part 2) (Tutorial) https://www.youtube.com/watch?v=XCnI6ZOYKes How does a Transistor Work? (Tutorial) https://www.youtube.com/watch?v=IcrBqCFLHIY
Making the Motors Work	D.C. Motor Working (Tutorial) https://www.youtube.com/watch?v=LAtPHANEfQo&t=65s Stepper Motor Working (Tutorial) https://www.youtube.com/watch?v=TWMai3oirnM
Physical Computing	https://www.youtube.com/watch?v=8npwSASQqyk
Arduino Getting Started	https://www.youtube.com/watch?v=grU7eNPBRxk&list=PLT6rF_I5kkn-Pf2qlVFlvH47qHvqvzkknd&index=1
More about Arduino*	Why Arduino? (Ted Talk by Arduino Founder) https://www.ted.com/talks/massimo_banzi_how_arduino_is_open_sourcing_imagination Anatomy of an Arduino Board https://www.arduino.cc/en/Guide/BoardAnatomy Arduino IDE https://www.arduino.cc/en/Guide/Environment Arduino Tutorials Playlist (Very useful for beginners,) https://www.youtube.com/playlist?list=PLA567CE235D39FA84 What all we can do with Arduino? https://www.youtube.com/watch?v=grU7eNPBRxk&list=PLT6rF_I5kkn-Pf2qlVFlvH47qHvqvzkknd&index=1 Arduino Basic Hardware Overview and Fundamental Code Commands https://www.youtube.com/watch?v=BtLwoNJ6klE

Programming	Programming Raspberry Pi* https://www.youtube.com/watch?v=eObSqbe9aqU
Physical Computing into Wearable Technology (Maker Story)	https://www.youtube.com/watch?v=LwOLbbPcduM&t=10s
Using Motor Driver Shields with Arduino	L298N using Motors with Arduino https://www.youtube.com/watch?v=nZdrWQcpb9E Stepper Motor with Arduino using L293D https://www.youtube.com/watch?v=nZdrWQcpb9E
How Servo Motor Works	https://www.youtube.com/watch?v=gviUtLsHDtg
Learn about Soldering Iron	How to Solder basics https://www.youtube.com/watch?v=BxeDkcAa4Fs Common Soldering Mistakes | Soldering https://www.youtube.com/watch?v=igqkhkff6cw
Tutorials showing usage of different types of sensors with Arduino Boards	Gas Sensors with Arduino https://www.youtube.com/watch?v=BIf_mpnsZvY Smoke and Gas Sensors https://www.youtube.com/watch?v=YgEOnZ-7i8o Calibrating with MQ2 Gas Sensors https://www.youtube.com/watch?v=YgEOnZ-7i8o Thermistor for Temperature Sensing https://www.youtube.com/watch?v=9opuvLXAetI Force Sensor with Arduino https://www.youtube.com/watch?v=1p8AE_QA8qQ Barometric Pressure Sensor with Arduino https://www.youtube.com/watch?v=s8e1eEqktm4 Ultrasonic Sensors (Very interesting project, it explains how radar works) https://www.youtube.com/watch?v=kQRYIH2HwfY GPS with Arduino https://www.youtube.com/watch?v=dy2iygCZTIM
Get inspired with series of ideas of DIY	http://www.instructables.com/tag/type-id/category-technology/chan- nel-arduino/

*All the links of the manual working on September 15, 2022