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).

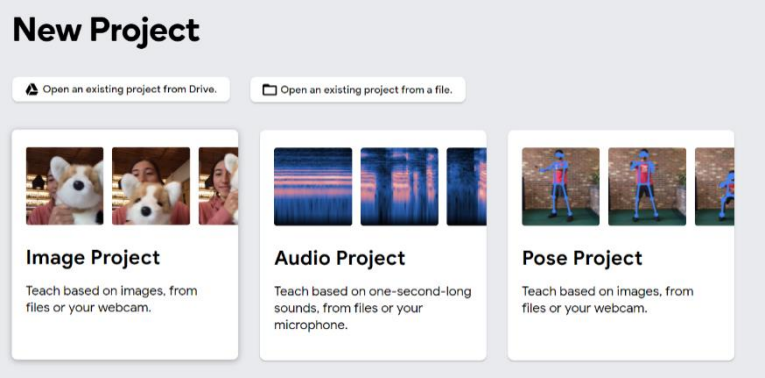
- How was your experience while manually segregating the domestic waste?
- Can you imagine the problems faced by people actively working at city waste management Head Quarter/plant?
- How do you think the management plans to get rid of this dump yard? (Hint: by burning plastic, rag pickers segregating 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.



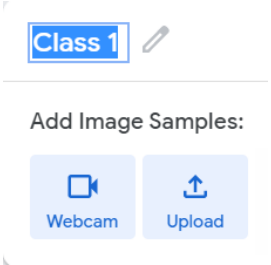
The Teachable Machine tool works in four steps:

3.2 Gather

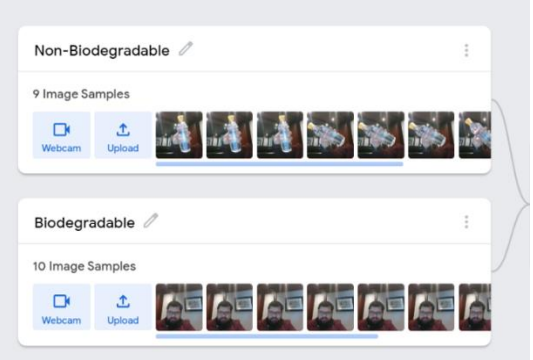
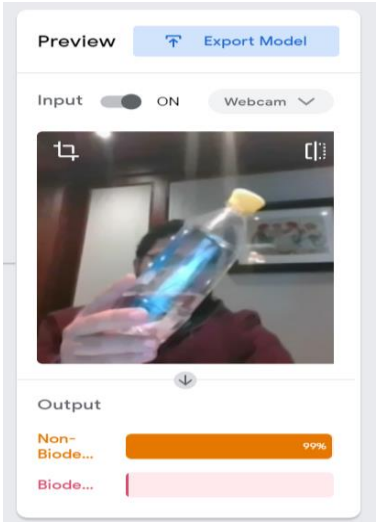
- Ask learners to collect waste materials they may find in their surroundings, OR
- Learners may use the images they had clicked during the take-home activity.

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

	 • 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 In charge)** 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=UsF5Isjdgw4 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
Learning Outcomes	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.

	• 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