

- Teacher guidelines for case study - Lagos Waste Management Authority (LAWMA)



Generic green skills

Cognitive competencies:

- Environmental awareness and a willingness to learn about sustainable development
- Systems and risk analysis, skills to assess, interpret and understand both the need for change and the measures required
- Ability to think about things differently

Interpersonal competencies:

- Consulting skills to advise consumers about green solutions and to spread the use of green technologies

Technological competencies:

- Management systems (waste)



Learning objective

Students are expected to:

1. Understand the closed-loop mindset in waste management.
2. Identify innovative solutions/technologies in waste management.
3. Provide suggestions to improve the waste management practice in LAWMA.



Format

Group discussion, presentation, and field trip



Role of teacher

Facilitator



Resources needed

A4 paper, laptop, internet, digital camera, student worksheet, case study



Time required

Two classes, 1 hour each; 3-hour field trip



Assessment

The assessment will be based on:

The group presentation that demonstrates, your understanding of the importance of closing the loops in waste management, and your ability to suggest innovative solutions/technologies to improve current practice in LAWMA.

Suggested teaching and learning sequences

Class 1

Before the class:

1. Ask students to read the case study “Sludge treatment in T-Park” provided online (<https://www.greenskillsresources.com/>), which explains the “waste-to energy” closed-loop for sludge treatment, by turning sludge into electricity.

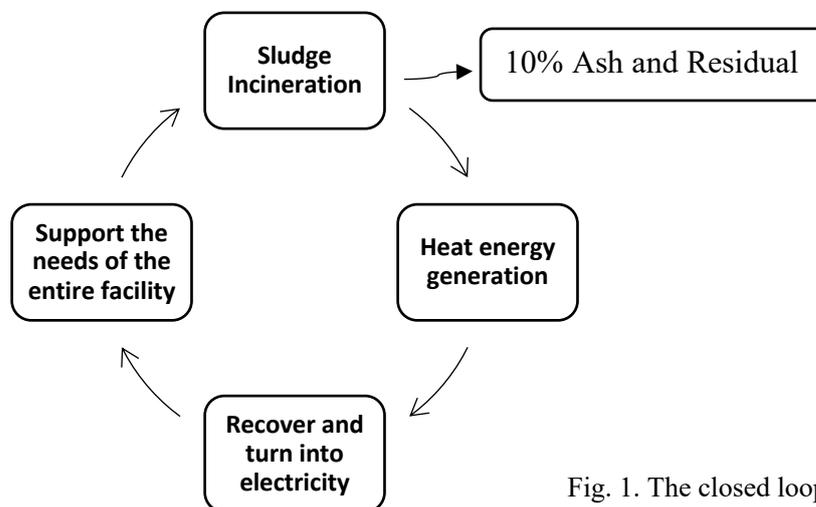


Fig. 1. The closed loop in sludge treatment.

2. Ask students to search online to identify different closed loops in waste management, such as food waste management and plastic waste management.
3. Ask students to read the case study “Lagos Waste Management Authority (LAWMA)” and identify the innovative ways/solutions/technologies used for waste management, such as engineered landfill. Ask them to do further research online if needed. Prepare their ideas to share in their groups.

During the class:

1. Group sharing

- a. Group students into groups.
- b. Facilitate students’ group sharing that focuses on:
 - i. Why the concept of a close-loop economy is important to waste management Use the case study “Sludge treatment in T-Park” to discuss this. Clearly list your arguments.
 - ii. Different kinds of closed loops in waste management.
 - iii. The innovative solutions/technologies for waste management and the issues they can address.
- c. Ask students to summarize their group discussions on A4 paper, and suggest they use different graphical forms to present their findings (e.g. graphs, a mind map and a tree map).
- d. Invite students to share their group discussion with the class (5 mins each group).
- e. Summarize students’ sharing using different graphs.

2. Plan a field trip

Help students to plan a field trip that focuses on:

- a. Observing the waste management solutions/technologies used in LAWMA.
- b. Identifying whether any closed loops can be identified in these solutions/technologies.

- c. Talking to the staff/managers at LAWMA to understand the challenges/problems they face in current practice and how they would like to improve their waste management practices. Prepare a list of questions, which can adjust during the site observation.

During the field trip:

1. Remind students to take notes of their observations.
2. Ask students to take pictures of objects and scenarios that impress them, and which are relevant to what they have discussed in class.
3. Suggest students talk to the LAWMA staff to identify challenges/problems, and any other issues they are interested in.

Class 2 (after the field trip)

Before the class:

1. Ask students to reflect on their notes and the pictures.
2. Ask students to identify closed loops in different kinds of waste management at LAWMA. If students cannot find any, ask them to try to design at least one based on one kind of waste management e.g. food waste, to share in class.

During the class:

1. Facilitate students to discuss the results of their field trip with their group particularly in relation to:
 - a. The challenges/problems faced by LAWMA.
 - b. The closed loops identified/designed for different kinds of waste management in LAWMA. Students should explain how they work and the issues they address.
2. Based on the identified/designed closed loops, ask students to provide suggestions about using innovative solutions/technologies to improve waste management practice at LAWMA.
3. Facilitate students' group presentation (PowerPoint)
 - a. Students should summarize their group discussions and identify the main ideas they want to present.
 - b. The group presentation should focus on explaining the identified/designed closed loops and making suggestions about using innovative solutions/technologies to improve current practice.
4. Ask students to start writing a letter to the LAWMA managers to introduce their PPT as the promotion material, and summarize how LAWMA can work further on the identified challenges to improve waste management practices.

After the class:

Ask students to:

1. Improve the PowerPoint based on comments from their teachers and students in other groups.
2. Finalize the letter and receive approval from you.
3. Send all materials to the LAWMA managers.

1. Group sharing

Facilitate students' group sharing that focuses on:

- i. Why the concept of a close-loop economy is important to waste management Use the case study “Sludge treatment in T-Park” to discuss this. Clearly list your arguments.

T. Park is an almost perfect example of a closed-loop enterprise. All its facilities and technologies are designed to use waste to produce energy. In particular:

- Sewage sludge is used as fuel, through burning, so the facility **turns sludge into energy**.
- Following incineration, sludge is converted into ash and residue – which results in a total reduction of 90% of the original sludge volume. This dramatically **cuts down the quantity of waste that needs to be disposed of in landfill and, as a result, reduces the emission of greenhouse gases by up to 237,000 tonnes a year**.
- All the heat energy generated from the incineration process is recovered and turned into electricity that can support the needs of the entire facility. When running at full capacity, it can also **produce up to 2 megawatts (MW) of surplus electricity for the public power grid, or power for up to 4,000 homes**.

Therefore, closed loops in waste management can help cut down the quantity of waste as much as possible, reduce greenhouse gases, and turn waste into materials of use e.g. electricity.

ii. Different kinds of closed loops in waste management.

Below are some examples of different kinds of closed loops in waste management:

- Closed loop in food waste management

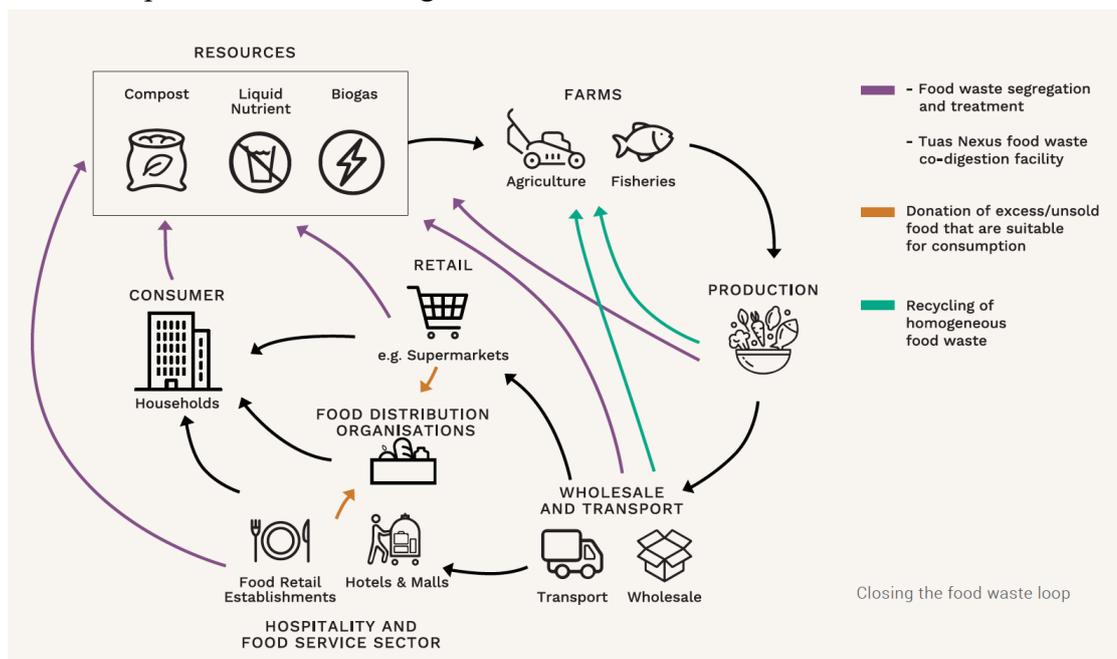


Fig. 2. Closing the food waste loop.

Source: <https://www.towardszerowaste.gov.sg/zero-waste-masterplan/chapter3/food/>

- Closed loop in plastic waste management

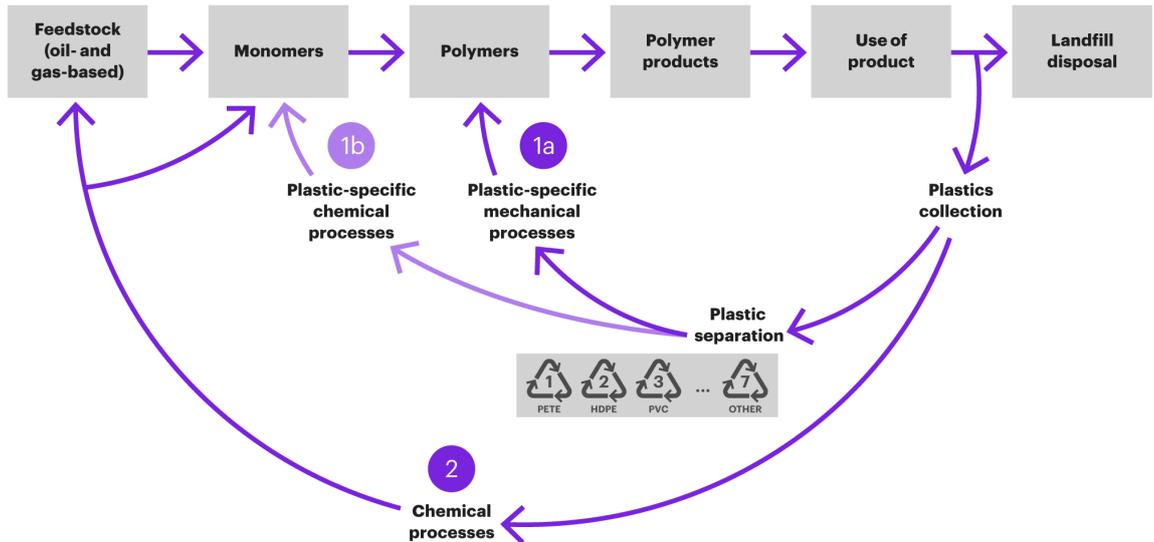


Fig. 3. Two closed-loop model for plastic waste management

Source: <https://www. Kearney.com/chemicals/article/-/insights/closing-the-loop-models-for-a-plastics-circular-economy>

- Closed loop in E-waste management



Fig. 4. Two closed-loop model for E-waste management

Source: <https://www.erm.com/insights/e-waste-turning-a-challenge-into-business-advantage/>

iii. The innovative solutions/technologies for waste management and the issues they can address.

You can suggest students search online using keywords, such as innovative solutions for waste management (general ideas), conversion of food waste into energy (specific ideas), and analyze the issues they can address.

Here are some examples for your reference:

- Smart waste bins

When left to their own devices, people don't always bother to sort their waste into the proper waste or recycling bins. To help reduce improper recycling sorting, Polish company Bin-e designed a smart waste bin that uses artificial intelligence-based object recognition to automatically sort recyclables into separate compartments. After sorting, the machine compresses the waste and monitors how full each bin is.

Smart waste bins take human error out of the initial sorting process, making material processing faster and easier for recycling facilities. This can lower waste management costs by as much as 80% and drastically improve employee efficiency.

Source: <https://www.bigrentz.com/blog/smart-waste-management>

- Solar-powered trash compactors

In an effort to increase collection efficiency and reduce trips to and from the dump, manufacturer Ecube Labs created a solar-powered trash compactor that can hold up to five times more than traditional trash bins. These machines compress trash as it accumulates to increase bin capacity, and they collect and transmit data about fill and collection times to help streamline the collection process.

Source: <https://www.bigrentz.com/blog/smart-waste-management>

- Transforming food waste into green energy

Researchers at Cornell University have found a new way to capture nearly all of the energy in a food waste product, leaving little behind for landfill. First, the researchers applied a method to “pressure cook” the waste and create a crude liquid that be turned into a biofuel. What remains is broken down into methane that can be burned to create electricity and heat.

The researchers show that by using hydrothermal liquefaction before anaerobic digestion, virtually all the energy is extracted from the food waste. In hydrothermal liquefaction, the waste is basically pressure cooked to produce a crude bio-oil. This oil can be refined into biofuel. Microbes anaerobically digest the remaining food waste, which is in an aqueous state, within days. The microbes convert the waste into methane, which can be used to produce commercial amounts of electricity and heat.

Thus, an effective method of turning food waste to energy carries benefits for humans, and the planet, beyond creating a new energy source. If humans do not capture methane, the heat-trapping gas enters the air and contributes to climate change.

Source: <https://www.sciencedirect.com/science/article/abs/pii/S0960852417302249>

Class 2 (after the field trip)

1. Facilitate students to discuss the results of their field trip:

a. The challenges/problems faced by LAWMA.

It is suggested teachers talk to the LAWMA manager during the visit to get more information about the waste management practices at LAWMA.

Teachers can then focus the conversation to understanding the challenges with modern technologies currently used by LAWMA to tackle the ever-increasing waste generated in Lagos. Teachers can also discuss the suggestions, based on the identified challenges, with their students.

The following is a study that focuses on appraising the waste management practices at LAWMA for your reference:

https://www.researchgate.net/publication/322078283_An_Appraisal_of_Waste_Management_in_the_Lagos_Metropolis_A_Case_Study_of_Lagos_State_Waste_Management_Agency

This study revealed that a major drawback in service delivery by LAWMA is the breakdown of waste evacuation trucks. Other drawbacks include non-payment of collection fees by the populace, limited amount of equipment, manpower, inadequate maintenance capacity, as well as a lack of cooperation from residents in ensuring proper waste management (See Table 1 for more detail).

Questionnaire Parameters		No of Response	Percentage (%)
Does LAWMA have problems in waste management	Yes	202	73.45
	No	73	26.55
Problems facing LAWMA	Breakdown of waste evacuation trucks	154	56.00
	Collection of fees by LAWMA	48	17.45
	Others	73	15.64
Do LAWMA has enough machinery to carry out this exercise	Yes	68	24.73
	No	159	57.82
	No idea	48	17.45
Source of revenue by LAWMA	Great extent	41	14.91
	Fairly great extent	91	33.09
	Very low extent	143	52.00
Access to fund for Machinery procurement	Great extent	35	12.73
	Fairly great extent	102	37.09
	Very low extent	138	50.18
Adequacy of LAWMA maintenance capacity	Great extent	30	10.91
	Fairly great extent	96	34.91
	Very low extent	149	54.18
Adequacy of LAWMA manpower requirement	Great extent	43	15.64
	Fairly great extent	123	44.73
	Very low extent	109	39.64
Public participation in waste management	Yes	123	44.73
	No	112	40.73
	No idea	40	14.55

Table 1: Analysis of problems associated with LAWMA activities in Lagos State by respondents in the study area (Onuminya & Nze, 2017).

b. The closed loops identified/designed for different kinds of waste management in LAWMA. Explain how they work and the issues they address.

You can use the examples provided for class 1 to inspire students about how to design closed loops for different kinds of waste management and how they work.

2. Based on the identified/designed closed loops, ask students to provide suggestions about using innovative solutions/technologies to improve waste management practice at LAWMA.

You can suggest students reflect on the innovative solutions/technologies they discussed in class 1, and think about how they could adapt these solutions/technologies to address the challenges identified at LAWMA. For example, according to information in the case study, a pilot project on the conversion of waste food into bio-gas was conducted by LAWMA. Solutions 3, “Transforming food waste into green energy”, as the example prepared for class 1, can be suggested as an innovative solution for this.

Reference:

- Landfills | SSWM - Find tools for sustainable sanitation and water management!. Retrieved from <https://sswm.info/water-nutrient-cycle/wastewater-treatment/hardwares/solid-waste/landfills>
- LAWMA – Lagos Waste Management Authority (LAWMA). Retrieved from <https://lawma.gov.ng/>
- Onuminya, T., & Nze, E. (2017). An Appraisal of Waste Management in the Lagos Metropolis: A Case Study of Lagos State Waste Management Agency. *Nigerian Journal of Pure and Applied Sciences*.
https://www.researchgate.net/publication/322078283_An_Appraisal_of_Waste_Management_in_the_Lagos_Metropolis_A_Case_Study_of_Lagos_State_Waste_Management_Agency
- Pavlova, M., Chen, C. S., & Saral, A. T. (2018). Case study: Sludge-treatment in T-Park. Retrieved from <https://greenskillsresources.com/resources/uploads/page/110/document/Case-study---Sludge-treatment-in-T.-Park-20220520134128.pdf>