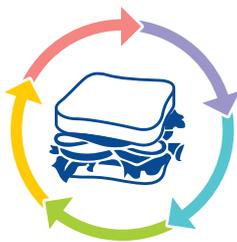
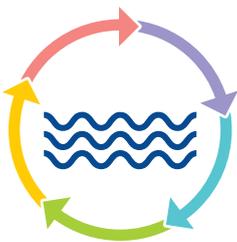


E_{co}-S_{chools} P_{roject} A_{dvancing} C_{ircular} E_{conomy}



E-SPACE

Eco-**S**chools **P**roject **A**dvancing **C**ircular **E**conomy



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CEE

Centre for Environment Education

Disclaimer: This publication has used resources, ideas and concepts from various products for an educational purpose. It does not promote or endorse any of the products or brands.

Message

“The E-SPACE project is the result of the strong cooperation among Lucart and FEE sharing the same vision in the cultural field. Teachers’ guidance is fundamental for young learners to develop their skills and to drive their actions. Teaching sustainability, circular economy will help to overcome environmental challenges in the future and schools are the perfect starting place to drive changes, improving our future. We, Lucart, try to be among the pioneers with the Natural project, and we are sure that when this process is finalized, our way of living will quickly follow. We want to bring the culture of sustainability into schools, since we believe that the development of a sustainable society can only be accomplished if businesses and citizens collaborate actively. We want to inspire new generations in adopting a sustainable lifestyle.”

Lorenzo Vaira

International Trade Marketing Manager, Lucart

“The environmental crisis is manifested in various forms requires a rapid change in how humans think of production and consumption. There is an urgent need to transform towards sustainability through positive actions. Education has a critical role in enabling this transition. Apart from education that drives change in the policies and economic systems, we need education that awakens consumers. Consumers are an important part of this transformation and they should be educated on the role that they need to play to support sustainable products and as citizens demand that there are wider incentive and mechanism to enable this change.

Through this pilot project, we hope to put forward a framework of education that supports consumer action towards advancing the circular economy. The project will motivate students and others to act with equity, empathy and solidarity as citizens of one planet.”

Daniel Schaffer

Chief Executive Officer

Foundation for Environmental Education (FEE)

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About us

Introduction

The current world is a paradox for human beings. We have been able to successfully raise our quality of life and standards of living since the industrial revolution. On one hand, this rapid advancement in a very short time of human existence on Earth has made our survival easier, but on the other hand, it has created economic systems that are heavily dependent on the use of energy and other resources. The exploitation of resources to meet the ever-increasing demands has degraded the nature of which we are part and on which we are dependent to meet our needs. The environmental challenges in a very short time of our existence on Earth have forced us to critically look at alternatives that can ensure sustainable development. Since time immemorial, one of the systems that humans have got their inspiration to learn and adapt is the natural world. Circular Economy (CE) as an idea is inspired by nature, a perfect design that renews, restores, and grows on its own with no concept of waste. It provides a regenerative framework for the paradigm shift to mirror natural processes to design our production and consumption (economic) systems to restore natural capital to the biosphere and use materials indefinitely in cycles of closed loops.

“science and machinery he (mankind) may get huge returns for a time, but ultimately will come desolation. We have got to study Nature’s balance, and develop our lives within her laws, if we are to survive as a physically healthy and morally decent species.”

- Mira Behn,

Mahatama Gandhi’s Follower (1949) quoted in Social Science textbook of class VIII, India

The Circular Economy is a new and emerging sustainability perspective. It proposes a system that generates resources at every step like in the natural world with the redesign of the products and services. The Eco-Schools Project to Advance circular economy (E-SPACE) is an attempt to simplify the concepts of circular economy and present it to the stakeholders in the school system to develop literacy amongst children. The two-year project pilots a methodology to prepare the younger generation with the knowledge of circular economy and empower them to take positive actions (handprint) for advancing circular economy. The project as a ‘whole school’ programme promotes critical thinking of how a school can model the concepts and principles of the circular economy to strengthen the literacy toward the vision of a sustainable world.

The goal is to change the mindset through critical thinking and put forward new ways of thinking to solve the problems. It aims to support the key role of education as an enabler to develop an individual with educational opportunities that match their capabilities and

through actions at various levels, meet the aspirations of the society. Education for Sustainable Development (ESD), of which circular economy is an important element, shapes and strengthens the ability to assess the reality before us as individuals, social groups, organisations and states. It influences the way people think and allows people to create a safer, healthier and more prosperous world, thereby improving the quality of life.

Circular economy literacy is the development of knowledge, values, attitudes/dispositions/behaviours in form of handprints that puts the goal of moving towards zero waste as a key outcome using the key principles and strategies to increase circularity. Many will argue that transition to circular economy systems is more of a responsibility of industries and that has to be driven by governmental policy. Individuals as consumers/buyers and also as citizens are an important driver to motivate the industry to fasten the rate of transition. Active citizenship as an important outcome of ESD also motivates the government to frame and implement policies that support this transition. The entry point to circular economy education can be through any existing environmental education initiative like energy conservation, waste management, biodiversity education, climate change etc with focus on reducing waste. The literacy should motivate a person with competence to reduce the loss of material and energy at every stage of production and consumption through product and service redesign.

E-SPACE is a pilot being initiated in the Eco-Schools of Slovenia and Latvia with support from Lucart Group. This publication is designed for teachers and details the educational process as lesson plans to support the Seven Steps framework of the Eco-Schools programme. The project is supported by Lucart group. Lucart as a company sees circular economy as an important strategy for environmental stewardship. In order to speed up its transition, Lucart has joined the CE100 network of the Ellen MacArthur Foundation seeking to develop new opportunities.

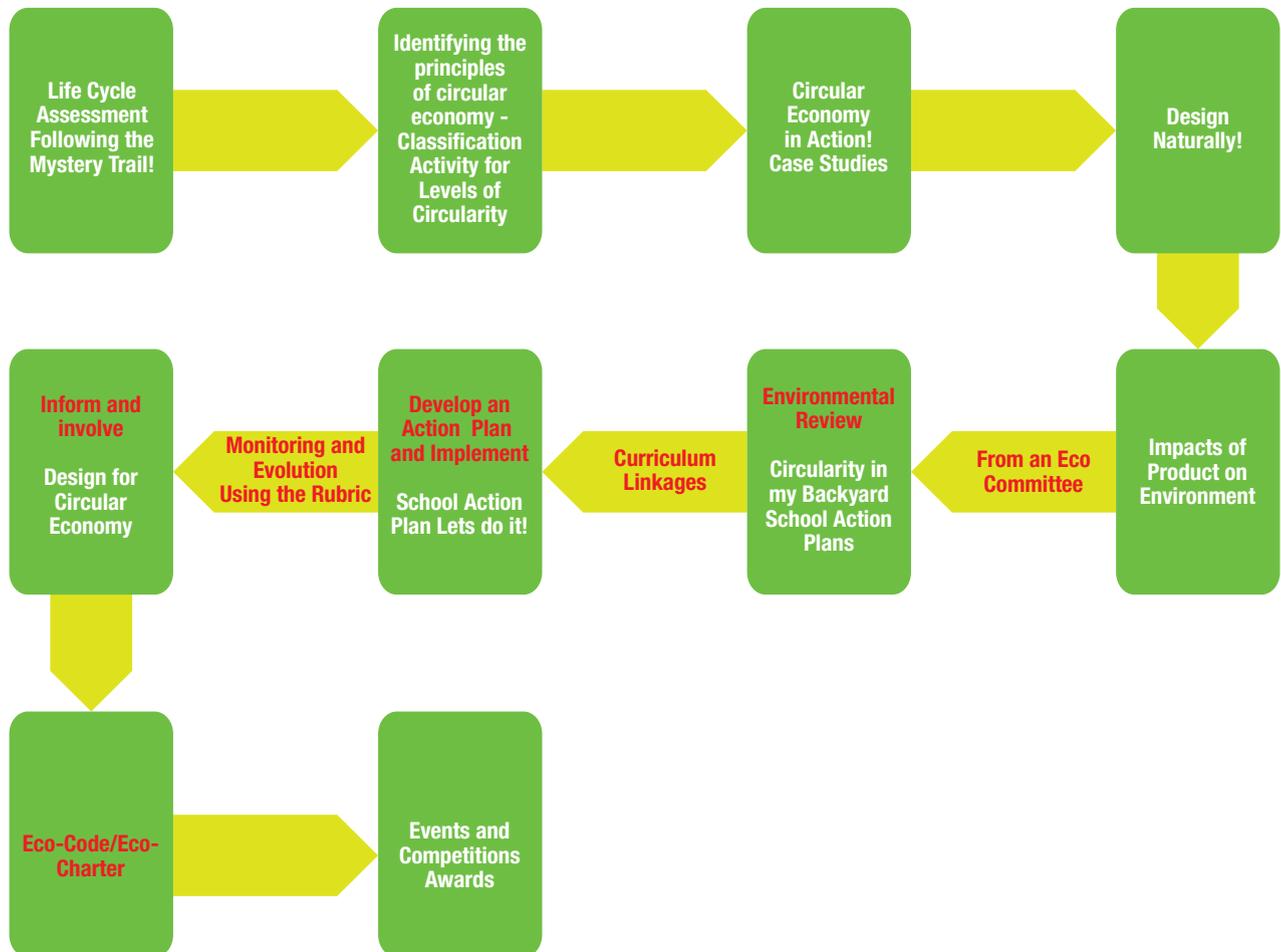
Circular economy as a content area is an integrative subject that can easily incorporate the actions being planned for various themes that include food, paper, clothing, plastic and IT equipment like cellular phones and computers. This as a pilot project, it would test our assumptions of how best circular economy education can be advanced globally. Please feel free to share your feedback to develop a robust pedagogy for advancing circular economy.

Pramod Kumar Sharma
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Linking the lesson plans to Eco - Schools 7 steps methodology

The Seven Step process is the basic framework that guides an Eco-School to plan and implement the learning journey. The steps are intended to be flexible enough to accommodate any school context, environmental themes. They are the means to bring about change through active involvement of young people through a rigorous pedagogical process. The nature of each of the Seven Steps and the order in which they are implemented allows for the incremental change in sustainability literacy through active learning as the actions of students improve the environmental performance of the whole institutions starting first with their behaviour. This process empowers them with the confidence to continue to positively influence themselves making the world a better place to live in.

E-SPACE project integrates the Seven Steps in the following ways





Following the Mystery Trail! Become a Detective!



Introduction

All organisms on earth including human beings go through a cycle of birth, life and death. This complex cycle is called a biological life cycle. They are a part of an ecological web of life where they are interdependent on other species and resources in nature. Any change in the way web of life works can have an impact on the entire ecosystem. A biological life cycle of an organism is therefore closely linked to numerous other components in nature and a change can impact many of these components.

Human activities and the increasing use of products that are “single-use” are causing damage to the environment. This adds non-biodegradable components to the environment therefore impacting natural balance. Production processes of these products require a variety of raw materials which are derived from natural resources. As the demand increases, it puts pressure on the resources and increases waste at the same time. It is therefore important to understand how our choice of products impacts the environment. A change in the way we think and design products is important. A life cycle assessment of a product is a useful method which helps us analyse the entire process from production to disposal and identify ways to reduce waste.

The Life-Cycle Assessment (LCA)

Life-cycle assessment is a method to analyse environmental impacts associated with all the phases of a product’s life from raw material extraction to materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Products in everyday use can be made of different types of materials such as paper, plastic, metal, wood, glass, rubber etc. Many of them though simple in form can have more than one material. For example, something as simple as a toothbrush might contain 7 to 8 different materials.

LCA helps provide a broader outlook on environmental impact of the product. The impact depends upon the complexity of the products and the possibility of extracting recyclable, reusable material before disposal. Products that can be reused, or recycled can decrease the environmental impact and are considered “environmentally friendly.” It is important to look at the products in this way to understand the overall impact of human activities on nature.

SDG Linkages



Types of life cycle assessments

- Cradle-to-Grave: The full life cycle of a product from raw materials (cradle) to the disposal phase (grave).
- Cradle-to-Gate: A partial product life cycle assessment that investigates a product from raw materials (cradle) to the gate of the manufacturing facility before transportation to the consumer.
- Cradle-to-Cradle: A product life cycle assessment, where the end phase includes recycling of the product into a new product. The recycled product can be identical or different from the original product.

Classroom Activity: Life Cycle Assessment of a Product

The activity encourages students to visualize the life cycle of a product and understand the different resources that are used and waste generated.

Learning Outcomes

Students will be able to

- identify different materials and energy which goes into making products.
- list the plausible environmental impact of the products.
- apply the life cycle approach to study the life cycle of a product.
- critically think about the environmental impact of the product before buying.

Time Required/Duration

- Total 60 minutes
 - Part 1: Analysis – 30 Minutes
 - Part 2: Discussions – 30 Minutes

Resources required

- Pencils
- Simple products like toys, toothbrush, food wrappers, books etc. (something that is easily available and relatable to the students)
- Tools like scissors, allen keys etc. for disassembling product (only if required)
- Life Cycle Assessment Worksheet



Procedure

- Divide the class into teams of three students each.
- Give each group a product for which to conduct a life cycle assessment using the worksheet 1.1.
- Give 15 minutes to students to complete the Life Cycle Assessment of the product given to them.
- Ask the groups to determine a score using the worksheet 1.1 for the impact of their products on the environment for comparison.
- Ask the students to total their points in the end.

Discussion

- Ask teams to share their total scores with other groups. On the board, create the list of products and scores from the groups.
- Discuss the range of impacts the products have on the environment.

* Waste reduce total scores of the products

Assessment

Ask the students to conduct an improvement analysis and present

- What could you change or improve in your product to improve its impact on the environment?
- Look at your Improvement Analysis above. Re-calculate your score if you were to use the improvements you just described. Did your score change? By how much?
- What would you need to do to reduce the environmental impact of your product even more?
- Weigh the environmental cost you've explored in this Life Cycle Assessment vs the function and usefulness of the product. Does your product make the world a better place? Why?



Worksheet 1.1

Product Development and the Environment Activity – Life Cycle Assessment Worksheet

Product that you are assessing: Microphone

Inventory analysis

Step 1 Materials Acquisition/Extraction: Each material in a product has its own life cycle of use and waste. List all the materials (metal, plastic, paper etc.) in your product. One point is assigned for each of the material used in the product.

Type of Raw Materials (List All)	Points (1 point per material)
Battery	1
Steel	1
Capacitor	1
Switch	1
Charging Plate	1
Cable	1
Copper coil	1
Total Points	7

Step 2 Materials Processing: Most of the objects we use daily must be processed before they are in a useful form for manufacturing. Again, list the metal and plastic materials in your product. Assign one point for each material.

Metals and Plastics in the product (List All)	Points (1 point per material)
Steel	1
Copper	1
Aluminium	1
Iron	1
Plastic	1
Total Points	5



Lesson Plan 1

Step 3 Manufacturing: All of the processed materials in your product must be formed and shaped into something useful for the product (like a metal screw or a plastic lever). List the different parts and pieces of your product that have been manufactured. Assign one point for each part

Different Parts/Pieces in the Product (List All)	Points (1 point per material)
Metal Capsule	1
Magnetic core	1
Switch	1
Copper coil	1
Receiver	1
Sound Windscreen	1
Total Points	6

Step 4 Packaging: How is your product packaged for sale? Mark the boxes that correspond to the packaging of your product here. Add of the total points for the packaging of your product.

Packaging and price tag	Points	
None	0	<input type="checkbox"/>
Paper or Cardboard Packaging Only	5	<input type="checkbox"/>
Plastic Packaging Only	15	<input type="checkbox"/>
Plastic and Cardboard Packaging	10	<input type="checkbox"/>
Styrofoam or Rubber Packaging	15	<input type="checkbox"/>
Instruction sheets included separately in package	5	<input type="checkbox"/>
Total Points	30	



Lesson Plan 1

Step 5 Transportation: Once a product is packaged, it needs to be transported to somewhere else for storage or sale. Transportation by trucks, planes or boats require fuel for energy and contribute to air pollution. Mark the box if your product uses transportation in any way. List the total points for the transportation of your product

Transportation	Points	
Yes, by Plane, Truck, Car or Boat	15	<input type="checkbox"/>
None- sold at point of manufacture	1	<input type="checkbox"/>
Total Points	15	<input type="checkbox"/>

Step 6 Use of the Product: all products have an amount of time that they can be used and reused. Check the box below that describes how long your product can be used.

Use Of Product	Points	
Product can be used once	15	<input type="checkbox"/>
Product can be used for 5 years	10	<input type="checkbox"/>
Product can be used for over 10 years	5	<input type="checkbox"/>
Total Points	10	

Step 7 Disposal: Once a product has been used, it can be disposed of or recycled. Check the box which describes your product below.

Disposal of the Product	Points	
Product must be thrown away	15	<input type="checkbox"/>
Some product materials can be recycled	5	<input type="checkbox"/>
All the product materials can be recycled	0	<input type="checkbox"/>
Total Points	5	



Impact analysis

Add up the points for your product to determine its overall impact on the environment:

Steps	Points
1) Type of Raw Materials	9
2) Plastics or Metals in the Product	5
3) Different Parts/Pieces in the Product	6
4) Packaging and price tag	30
5) Transportation	15
6) Use Of Product	10
7) Disposal: Parts of the Product Made from Plastics or Metals	5
Total Score:	79

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Adapted from <http://www.vestaeducation.com/viu-education-program/environmental-impact-study-lesson-plan>

Identifying the Principles of Circular Economy



Introduction

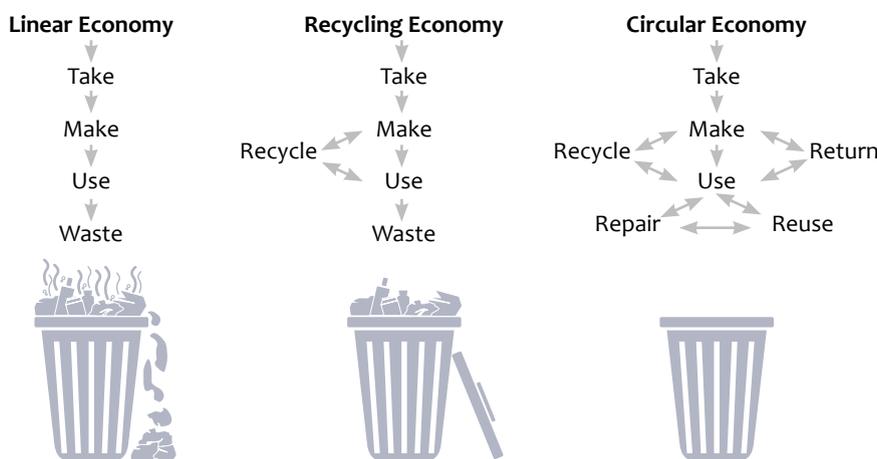
The current production and consumption is an extractive industrial model that has a linear process which is to Take, Make, Use and Waste. Such **Designed to Dispose** model has a very high environmental impact. The waste pollutes water, air and land that harms the life forms. In comparison to the Linear Economy model, the circular economy model aims to enhance sustainable growth and consumption through efficient utilization of by-products including waste from the production and consumption process. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution from the system through which a product or service is created and delivered.
- Keep products and materials in use overtime through durability (repair, refurbish etc.) and recycling of material.
- Use renewables and regenerate natural resources by sustainable extraction within its carrying or regeneration capacity and restoration.
-

What makes Circular Economy important?

The current economic model works in a linear way. As shown in the picture comparing the systems, we extract resources and use them as per our convenience and disposal waste. This takes a toll on the environment as the materials are extracted from the nature in a raw form, and disposed in an unnatural way.

SDG Linkages



Source: Finalstraw - <https://www.instagram.com/p/By30QuxgqGV/>

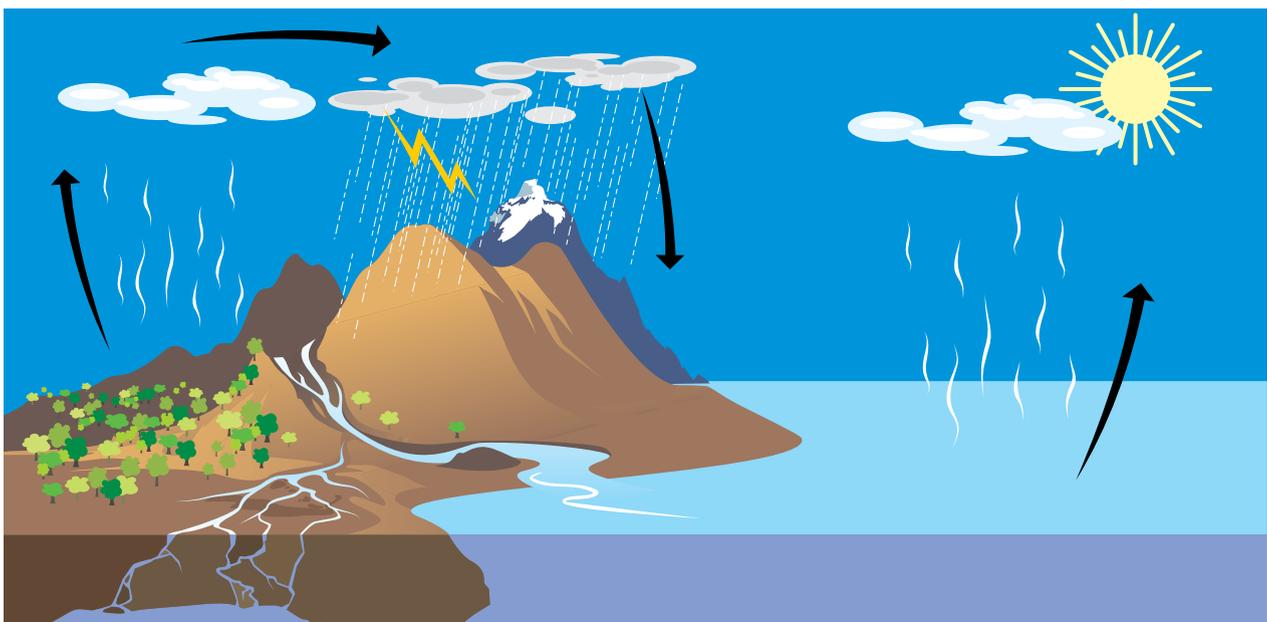
The recycling economy is slightly efficient than a linear economy as it tends to take some of the material back into the system and gives new life to it. However, the collection system as well as the complex chemistry of different materials makes it difficult to recycle all the products. Thus, recycling is efficient but only to some extent.

Circular economy applies a set of complex processes meant to close the loops of material cycles by following the natural cycles. The process aims at eliminating waste at all levels by utilizing it in some way or the other. circular economy also aims at extending life of materials by repairing, repurposing as well as recycling.

The natural balance

There is no such thing as waste in nature as through its natural cycles, it breaks down everything that is part of its ecosystem, and reuses it in the form of food or directly in the form of energy. Since waste is produced by materials that humans have developed and is something that holds no value in natural systems, it is hard for nature to treat it on its own. This means that there is a disturbance in the natural balance because of the extraction of natural resources to make products and disposal of the waste that is generated. The concept of circular economy is derived from the natural cycles to enable all material production to have a circular approach.

The Water Cycle



Images : CEE Illustration Bank

Classroom Activity: Circularity in our daily life

The activity encourages students to participate in circular thinking. It engages students in group work to sort and categorise circularity of different objects they use in daily life. It encourages students to strategies and communicate the concept of circular economy to influence the buying choices.

Learning Outcomes

Students will be able to

- compare living systems with man-made systems.
- relate to the lack of waste in nature due to the circular flow.
- identify that current system of production and consumption is linear flow.
- distinguish linear flow from the circular flow.
- evaluate levels of circularity of products and services.
- begin to investigate a circular economy as an alternative model to the linear economy.

Time Required/Duration

Total 90 minutes

Part 1 : Class room Discussions - 45 Minutes

Part 2 : Activity - 45 Minutes

Resources required

- Products in the five categories – Food, Paper, Plastic, Metal, Glass (Packaged food, Fruits/ Vegetables, Books/Notebooks, Plastic bottle, Metal Key/container, Glass bottle) OR Product Name cards.
- Cards or Sticky notes for each group.
- A3 sheet of papers (one per group).
- AV system with internet to show film.

Procedure

- Make groups of 3 or 4 students, standing or sitting around a table.
- Give a product to each of the groups. Give a product name card in case products cannot be arranged.
- Give a set of blank cards or sticky notes to each group.
- Watch the Ellen Macarthur Foundation video, 'Rethinking Progress' (4 minutes):

<https://www.youtube.com/watch?v=zCRKvDyyHml>

Re-thinking Progress: The Circular Economy is a world of opportunity to re-think and re-design the way we make stuff. Re-Thinking explores how through a change in perspective we can re-design the way our economy works - designing products that can be made to be made again: and powering the system with renewable energy. It questions whether with creativity and innovation we can build a restorative economy.

- Ask the group to use the blank cards or sticky notes to tell the story of the life of the product by making a mind map.
- If required you could explain through an example. Say, they were to tell the story of the life of a plastic bottle.
- You may want to support them through the first few steps to write on the cards. You could ask, for example, where plastic comes from. When someone answers 'oil', ask them to write that and maybe also draw an oil rig on one of the cards. Stick the card on the A3 paper. Tell the class that this is their starting point. Then ask what happens next to the oil, which will likely lead into the oil being taken to a refinery, perhaps via a boat. An arrow from the oil rig to the next step and another will indicate the process. Every step should be recorded on individual cards or sticky notes and pasted on the A3 paper, with arrows to connect the steps. Also ask the students to identify natural and man-made materials while they are doing the activity.
- Ask the students to now do this activity for their products and classify their product as Linear, Recycling or Circular with explanation

Discussion

- Some questions to lead the discussion could be
- Which of these have a wasteful, linear process?
- Which of these products can biodegrade and become a part of the natural system? Discuss about the way a foodchain is at the heart of the biological system.
- Why is there no waste in natural systems ?

Assessment

- How can we design a system that reduces waste?

Bibliography

- Adapted from resource developed by Ellen Macarthur Foundation.

<https://www.ellenmacarthurfoundation.org/assets/downloads/schools-colleges/Schools-Colleges-WLL-Lesson-Plan-2-V2.pdf>

Circular Economy in Action!



Introduction

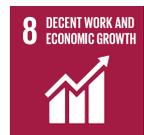
Many individuals, organisations and companies have started to make a transition towards incorporating principles of circular economy in their work. Although the circular economy framework combines several schools of thought, philosophies and principles it is essentially based on three main principles:

- a) **Reviewing the current system and reworking it to not produce waste.** This is the first and the most important step. This is achieved by designing products or services that are durable hence do not need frequent replacement, are repairable and use materials that are reusable or recyclable. The durability can also be built in by motivating companies to lease or hire products that encourages repairs against replacement and use of materials that can be reused or recycled. Optimum utilization of resources decreases the need of new products for example an app based car hires has potential to reduce the need to own a car that may lie idle a large part of the day. This reduces emission as total number of cars required decreases.
- b) **Separating the biological (compostable organic material) from technical (non compostable such as metals and plastics) materials.** Biological are returned to the biosphere as nutrients, and the technical are recycled indefinitely. This requires our participation in the segregation of waste at source, for example, at home, putting green waste for composting and the other recyclable waste for recycling.
- c) **Using renewable energy** to decrease dependence on coal and other fossil fuels.

Circular economy is an integrative idea that builds upon key sustainability perspectives that inform the set of three basic principles discussed earlier. Some of these include:

1. **Biomimetic or Biomimicry:** It is an approach to learn from nature for finding a solution to meet our needs and challenges which have been there around us and have inspired us to learn from its patterns and strategies. In the context of sustainability, the aim is to identify/ recognise products, create new products, processes, and policies that are in harmony with the life on earth.
2. **Cradle to Cradle:** It is also called Regenerative Design that imitates cyclic natural systems where output/s is an input for the next step of the process. The approach challenges the current Cradle (Resource Extraction) to Grave (Landfill Disposal) production and consumption approach and suggests that industry must protect and enrich ecosystems and nature's biological systems through cyclic processes.

SDG Linkages



3. **Performance Economy:** It is a Cradle to Cradle “closed loop” approach to production processes that pursues goals of extension of life of a product, durable goods, reconditioning activities (remanufacturing, refurbishing, and repair) and prevention of waste. It also insists on the importance of selling services instead of goods like car hiring rather than buying cars.
4. **Industrial Ecology:** It looks at the material and energy flows through industrial systems and makes connections between business operators within the ‘industrial ecosystem’. This approach aims at creating closed-loop processes in which waste from one industry or process serves as an input for another, thus eliminating the notion of an undesirable by-product or waste. With an emphasis on natural capital restoration, industrial ecology also focuses on social wellbeing.
5. **Natural Capitalism:** “Natural capital” refers to the world’s stocks of natural assets including soil, air, water and all living things. It is a global economy in which business and environmental interests overlap, recognising the interdependence that exists between the production and use of human-made capital and flows of natural capital. The concept of natural capitalism is based on the principles of radically increasing the productivity of natural resources, shift to biologically inspired production models and materials with no concept of waste by modelling closed-loop systems on nature’s cyclic designs where every output is either returned harmlessly to the ecosystem as a nutrient, or becomes an input for next step in the process/flow, move to a “service-and-flow” business model that provides value as a continuous flow of services rather than the traditional sale-of-goods model reinvest in to restore and regenerate natural resources increases.

Classroom Activity: Circular Economy - Discussing Case Examples

The activity analyses different case examples of businesses that have incorporated principles of circular economy.

Learning Outcomes

Students will be able to

- identify resources that are used to produce products and services that we consume in our daily life.
- identify that CE is not a new concept but amalgamation of many strategies in practice that requires commitment through promoting reuse, repair, refurbishment, recycling, product design and manufacture, and fostering system eco-effectiveness.
- illustrate through examples that CE involves identifying and implementing pathways through manufacture, use, reuse and recycling processes that drastically reduce or even eliminate the generation of waste.

A circular graphic with a green center containing the text 'Lesson Plan 3'. The center is surrounded by a ring of colorful segments in shades of blue, green, yellow, orange, red, and purple.

Lesson Plan 3

- list the key principles of a circular economy that includes “designing out” waste, separating the biological from technical nutrients where the first are returned to the biosphere, and the second are reused indefinitely, and using renewable energy to “decrease resource dependence and increase system resilience”.
- give some examples of products that have adopted the circular economy principles.

Time Required/Duration

90 Minutes of classroom session

Resources required

- Chart papers
- Writing material
- Computers with access to internet.

Procedure

1. Divide the students in groups of 5 to 8 members each.
2. Assign a case example to each group. A case example may also be given to multiple groups for discussions.
3. Ask the students to read the case example and discuss the following questions:
 - a. What are the environmental, social and economic benefit/s the product or service is bringing about?
 - b. Why do you think the products/service qualify as examples of circular economy?
 - c. What are the key principles or strategies being used to support environment?
 - d. Give some more examples around you that you think use similar principles or strategies?
4. Ask the groups to present the case example in brief and their reflections on above questions to the class.

Assessment

Assess the presentation and discussions for the clarity on principles of Circular Economy.

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2. <https://loopstore.com/>
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Case Examples

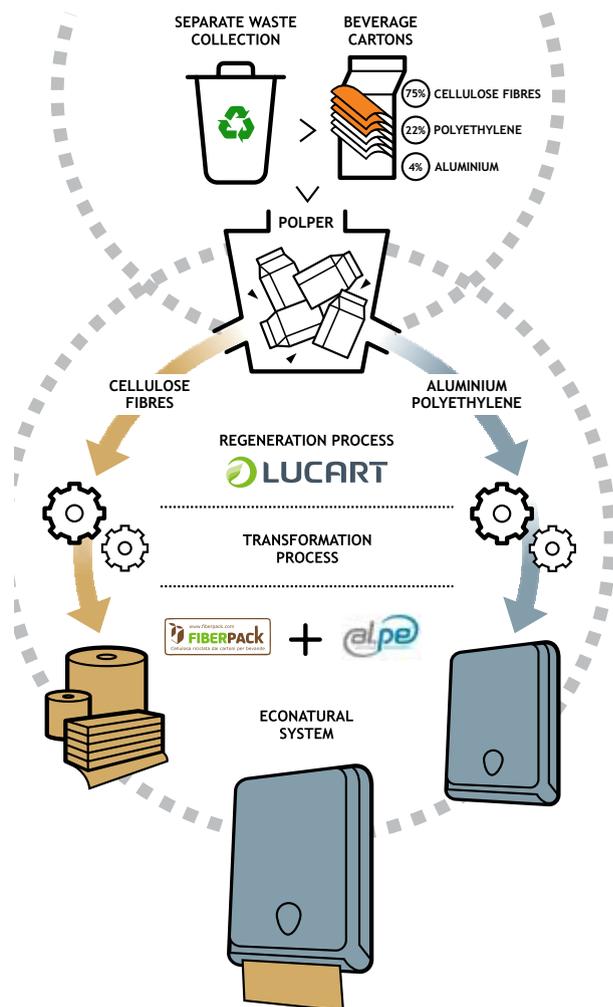


1. Hygiene for a Sustainable World!

The Lucart group is the first company to launch a circular economy project in the field of “tissue” paper through a recycling programme in which waste becomes a resource. Over 4.4 billion Tetra Pak® type beverage cartons have been recycled and that has resulted in avoiding use of 1.9 billion trees equivalent to 6500 football grounds and prevented 114,500 tons of CO2 emission. Cellulose fibres present in Tetra Pak® type beverage cartons are recovered to obtain a material called Fiberpack® . By weight, a carton has 74 percent cellulose fibres in addition to 22 percent polyethylene and 4 percent aluminium. The company proposes that by 2020, they will be reaching the point of recovering one and a half billion beverage cartons per year for recycling.

How does it work?

- The starting point is collection of the beverage cartons for recycling. To reduce the bulk in transportation, the containers are folded and compressed once residual food waste has been eliminated, and then the process that will transform them from waste into a secondary raw material begins.
- After the sterilisation and mechanical processing of the collected cartons, the cellulose fibres are separated from all the other materials. The fibres recovered through this process form the basis for creating Fiberpack®, a material used to make paper products (toilet paper, napkins, tissues and towels) certified with the EU Ecolabel.
- The EcoNatural and Grazie Natural brands have a natural light sand colour due to the fact that the cellulose fibres are not bleached further reducing use of material and waste. The products are characterised by high levels of robustness, absorbency and softness, and are 100 percent environmentally friendly.
- In addition to cellulose, materials such as polyethylene and aluminium are also



Source : Lucart-EcoNatural: <https://www.lucartprofessional.com/en/united-kingdom/lucartsas-export/innovations/econatural/>

recovered. These are used to produce aluminium polyethylene, a material recovered and re-used by manufacturing industries for numerous purposes, from construction to urban furniture, from everyday objects such as pens and rulers to pallets for transporting goods, from systems for dispensing hand-towels in bathrooms to the mooring poles used in Venice.

- In addition, the company has also developed Single-sheet dispenser systems that combine savings and hygiene.

Adapted from the information available on the website at <https://www.lucartprofessional.com/>

Video - Lucart EcoNatural, available at https://www.lucartprofessional.com/fileadmin/templates/lucartprofessional2014/video/Lucart_EcoNatural_short_ENG.mp4

Labeling of the Hygiene Product

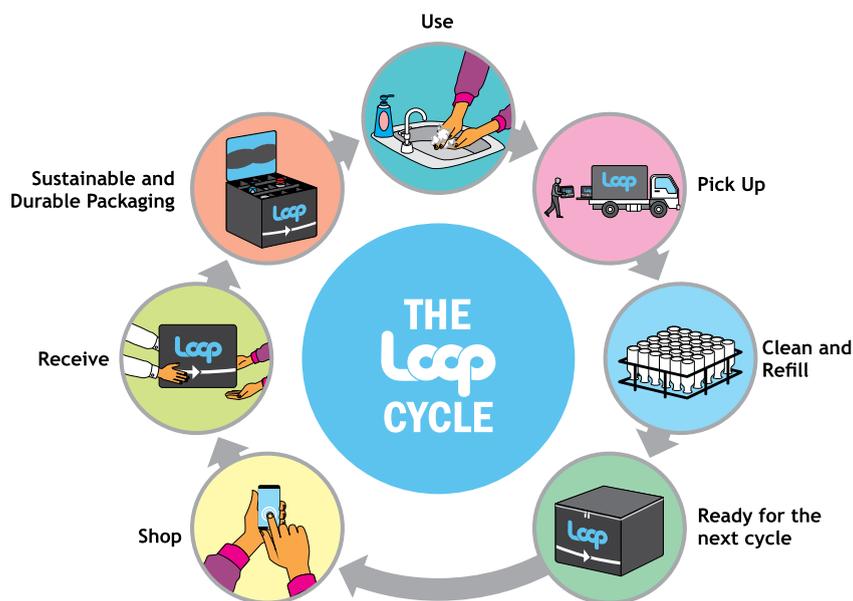
	<p>Fiberpack® is raw material obtained from recycled cellulose fibres contained in beverage cartons. Fiberpack® is an environmental and technological success grown out of the association between Lucart and Tetra Pak®.</p>
	<p>FSC® is an international non-governmental organisation that promotes the responsible use of forest resources. EcoNatural paper products are FSC® recycled-certified</p>
	<p>EU Ecolabel certifies that products respect the strict environmental protection requirements, throughout their life, which all EU countries share: low water pollution, low air pollution, low greenhouse gas emissions and low electric power consumption. The paper products of the EcoNatural line are EU Ecolabel-certified.</p>
	<p>PEFC™ certification ensures that the management of forests, from which cellulose is derived, meets specific environmental sustainability and social requirements established at European level. Paper products of the Strong line are PEFC™-certified.</p>

Source : <https://www.lucartprofessional.com/en/united-kingdom/lucartsas-export/innovations/econatural/>

2. Fill it Again and Again– The never ending Loop!

Single-use packaging and product waste is one of the most pervasive and rapidly growing issues. The primary reason for it is increasing consumption in amount and variety of disposable items, a very small percentage of which is recycled. The ‘take - make - use - waste’ philosophy of consumption has taken over lifestyles because it gives us unparalleled convenience at an affordable price. Reusing an object saves time, energy and resources and does away with the need for waste disposal or recycling. Consider ‘the milkman’, where consumers would purchase milk in durable glass bottles, which were then collected and refilled when empty. This reuse eliminated the need for new energy and resources to manufacture another bottle for our next purchase of milk. Recycling is important but it requires an object to be broken down at the material level to be used for producing new things, thus requiring energy.

TerraCycle is a private U.S. recycling business headquartered in Trenton, New Jersey. It primarily runs a volunteer-based collection of litter or non-recyclable waste from pavements, and then partners with corporate donors or municipalities to turn it into raw material to be used in new products. The company licenses its name to roughly 200 products made using its raw material. TerraCycle’s goal is to focus on hard-to-recycle materials, developing circular solutions for otherwise linear systems to divert these materials from our landfills and incinerators.



How does it work?

- The starting point is to look at a waste stream with an aim to moving it from a linear disposal system to a circular one, and then over time to a platform that is as closed loop as technically possible. To make sustainability accessible, TerraCycle created Loop to combat single-use waste. Through Loop, consumers can receive their favourite products from trusted brands in durable, reusable packaging through e-commerce shopping. The company has teamed up with leading global manufacturers and retailers (as well as start-ups and local companies) to reimagine their products and the operations behind them.
- The company believes that those who design products should be responsible for them through their entire life cycle. The consumer is not responsible for any wear and tear of any Loop item, from a product to the Loop Tote. The consumer is only responsible for sending it back so that it can go around the Loop again. The goal of Loop is to minimize all impacts, including shipping. The fulfilment solutions are as efficient as possible, including offering a shipping discount to ship full Loop Totes - so not only do the consumers benefit, but the planet does too. Loop also works with one of the most sustainable shipping companies in the world, UPS as pick-up and delivery provider, so that it can further reduce the company's carbon footprint. Rather than delivering a small number of goods and deploying numerous franchised or crowd-sourced drivers like other logistics and delivery companies, UPS's consolidated approach to bundling deliveries into routes they are already driving means that there are no new trucks on the road.

Adapted from the information available on the website <https://loopstore.com>

Video available at Youtube - TerraCycle Introduces Loop: https://www.youtube.com/watch?time_continue=3&v=fBwsWuJw-Kc

The video explains how Loop, a sustainable e-commerce platform delivers products of daily use through a zero-waste model. TerraCycle - Loop provides these products in durable and reusable containers.

Lesson Plan 3

3. Latest Upgrade - Ethics in a Smartphone!

The current market of mobile phones encourages throw away culture as most phones aren't built to last and this planned obsolescence encourages the consumers to constantly upgrade to new devices. Some of the discarded phones are recycled in accordance with prevalent guidelines and rules, others are recycled under dangerous working conditions or end up in landfills. Change doesn't happen overnight and Fairphone as a company is building a movement to show the demand for fair products by changing the way phones are made, used and recycled.

The company's main focus is to make sure that it sources its materials from non-conflict mines as well as improving the livelihood of local mining communities. One of the big problems in the country is the small-scale informal mining that involves some 1.8 million people. The need to wrest control on the resources has led to wars and conflicts leading to deaths in millions since 1998. The focus is on the material that go into manufacturing of a smartphone. Fairphone is a social enterprise, with mission in mind to change the electronics industry and raise the awareness of issues along the supply chains. The Fairphone has been using fully sourceable, **conflict-free tin and tantalum**. The aim is to give visibility to the situation in Democratic Republic of Congo that supplies the minerals and metals essential to the manufacture of mobile phones.

Fairphone is promoting reuse and recycling in its attempt to move closer to a circular economy by encouraging the reuse and repair of phones, researching electronics recycling options and reducing electronic waste worldwide. The company produces modular phones that encourage replacement of some of the defective components. The company sells spare parts and offers repair tutorials to help make your phone useful for as long as possible. The company supports recycling programmes to ensure valuable materials can be used again and again. There are over 30 non-renewable minerals nestled behind the screen of a phone, each one with its own complicated history, from mine to factory to phone. According to a recent UN University report, over 50 million tonnes of e-waste is produced every year, only 20 percent of which gets recycled. With the help of their partners, the company is trying to find creative ways to maximize the value of the resources used in phones. They started collecting electronic waste from countries like Ghana, Uganda and Rwanda who were struggling with electronic waste. A system has been setup to take back used phones, selling refurbished phones, and researching the best ways to recycle old Fairphones. The company provides free shipping label to send old mobile phone(s).



Lesson Plan 3

Fairphone as a device is an idea to prove to customers and to multinational corporations, that it is possible to create phones that are conflict free, ethical and sustainable. The Fairphone was launched in 2013 as a concept through a crowdfunding campaign that presold 25,000 handsets before a single device rolled off the production line. The company has sold over 82,000 phones and in the process supporting local economies rather than the militias. The company is aiming to sell 140,000 devices, and that is a very small share in the global market. To compare, Apple sold 13 million iPhone 6s in its first weekend alone. The Fairphone isn't as sleek as the new Apple iPhone and nor does it have as many specs as the latest Samsung Galaxy S. But Fairphone hopes that it has a real design advantage - its modular design. This enables the consumer to take it apart and fix it. The company aims to change the commercial model that incorporates economic system and a market mechanism to put idealist values into the core of what moves the world. They do not claim to become the biggest phone company in the world but show that there is a market by increasing demand of such products and encourage bigger players to follow.

Education is the first step in taking action against the world's e-waste problem. To generate demand through education, the company organises workshops that takes consumers through a journey deep into the stories of the phone's making, and lets them extract some of the reusable materials for recycling. The Fairphone has been given "Best in the industry for greener electronics awards" by Greenpeace and got the first perfect 10 on **iFixit's repairability score**.

Fairphone is also promoting improved working conditions for its workers to be able to share their ideas and concerns to improve their working experience. With a selection of manufacturers, they assess the factories and collaboratively make improvements, focussing on health and safety, working hours and communication channels.

Fairphone Focus Materials



● Fairphone Facility
Netherlands

● Gold from
Peru

● Tantalum and Tin
from Conaco

● Tungsten from
Rwanda

Copper from recycled sources*

Adapted from the information available on the website at <https://www.bbc.com/news/business-35094050>

Video available at

<https://www.fairphone.com> , <https://www.impossible.com/fairphone> and <https://www.bbc.com/news/business-35094050>.

The video is about Fairphone, the social enterprise based in Amsterdam that develops smartphones that are designed and produced with minimal harm to people and planet

4. Cycle to Sustainability!

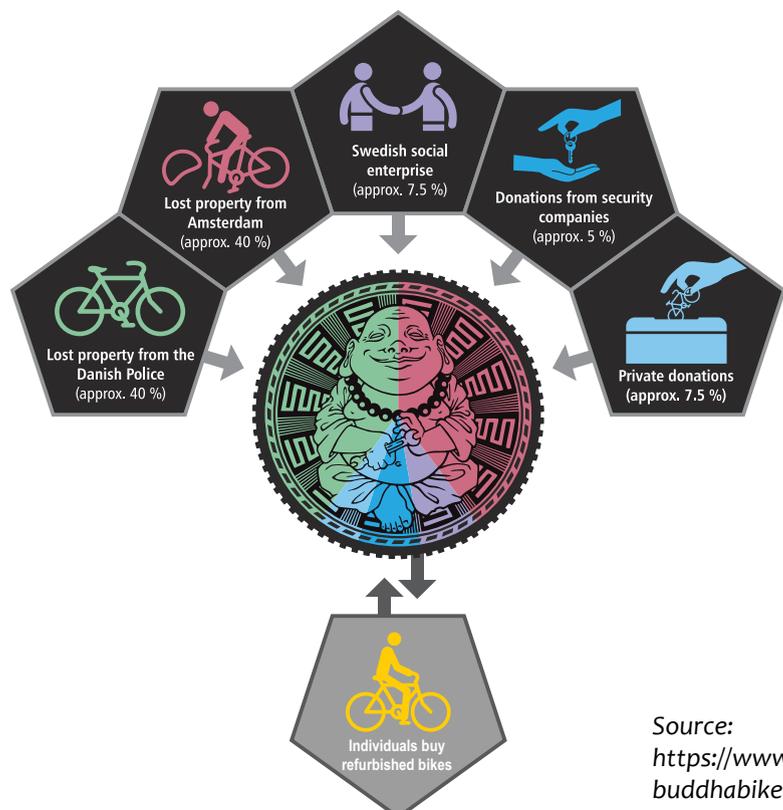
Buddha Bikes operates in Copenhagen, Denmark with an aim for promoting bike-love and effort to change the unsustainable ‘consume-and-waste’ culture. People in Denmark on an average buy 1370 bicycles a day. A European produced bicycle emits 223 kg of CO₂.

The idea emerged to refurbish and build second-hand bikes, and sell them to put an end to the waste. The purpose is for both people and the planet. All the bikes that are sold are refurbished, reincarnated second-hand bikes. The company refurbishes new bikes on original frames and recycled materials and thereby reduces CO₂-footprint by 40-50 percent, compared to a new bike.

The sourcing of the bikes to recycle has changed over the years and currently Buddha bikes get 15 percent of the bikes from private donors and 80 percent through a collaboration with 3 Recycling facilities through the company ARGO. When people go to the recycling facility with the intent of discarding the bike in the container for metals, they are presented with an alternative option. They can park it beside the container, by a sign that says “donations to Buddha Bikes” and in this way they donate the bike, instead of discarding the bike. The insurance companies supply 5 percent of the bikes for repairs.

The bicycle repairs and refurbishment also serves as bicycle mechanic education of the highest standard for youth who are on social support. Buddha Bikes creates courses for vulnerable youth in collaboration with the Askov Foundation. The youth taken in for training are under 30 years of age and are on state unemployment support. At Buddha Bikes, they stop getting paid by the state. The youth are trained to refurbish second-hand bikes that requires a multitude of skills compared to fixing small issues on nearly new bikes. The able and willing are given an apprenticeship with union-approved pay and educated as bicycle mechanics.

Where do Buddha Bikes come from?



Source: <https://www.buddhabikes.co/our-bikes>

5. Sustainability Starts at Birth!

As per the environmental assessment carried out on behalf of Nordic council of ministers, reusing clothes is up to 3000 percent more efficient than reusing clothes as fibres in new products.

Vigga as a company has come up with a business built on circular economy of renting organic garments to expectant mothers and growing up babies. The company provides baby clothes as a subscription service that can be changed with the growth of the baby. It is estimated that a baby grows 8 clothes sizes before his/her 2nd Birthday. The subscription ranges from small, medium to large depending upon the clothes a consumer might already have.

Vigga garments are designed to have a very long life, and the way the clothes are used, it promotes a system where resources are utilized optimally. When the clothes are worn out they are upcycled into new products. The business model demands high quality of clothes to ensure more circulation amongst users. Compared to 8000 different chemicals being used to produce an Ordinary T – Shirt, Vigga clothing are organic and free from chemicals and pesticides. This is achieved by control over the life cycle of products -from the cotton field, repair and cleaning between each customer and the finally recycled one day.

The consumer is guided to choose from the best collection composition but at the same time is free to edit the content and replace individual items at no extra cost. They give wide options of outerwear, swimwear and home knitwear. As the baby grows, the clothes are taken back to their headquarters to be checked for faults and washed in a unique way at low temperatures, which makes the garments free of microorganisms. The clean garments are again available for the next child!

The company encourages clothes to be used by the consumers as their own. By taking responsibility for the clothes and treating it with respect, the consumers help the concept succeed. There is an inbuilt insurance component into the subscription price. If the garment wears out or is lost, a replacement is sent. The company promotes repair, re-design or recycling by encouraging the consumers to return the damaged clothes. They either repair or redesign it, or eventually send it for recycling.

Lifecycle analysis Impact

Vigga 

90% lower water consumption
72% lower cotton consumption
53% less CO₂ emissions



The business model is very simple, the longer consumers are part of the Vigga, the more resources are saved and ensures baby's green future. Since Vigga started, families have saved up to 9.9 million litres of water and up to 185 tons of CO₂ by sharing Vigga clothes with each other!

Source: www.littlecandinavian.com

6. Ugly Food – A Waste that Does not Make Sense

Over the last 100 years, the agricultural system has been disrupted by several technologies that have transformed our food supply completely. Whereas food supply used to be from local farms that served local markets, it has become a vast global network of farmers, agribusinesses and stakeholders. The current food system strives to make all food available at all times and in all places. The drive for efficiency, higher yields and lower costs has led to several unforeseen issues, including of waste. Global food waste is a far-reaching problem with tremendous financial, ethical and environmental costs. The causes range from bumpy roads to overly-selective customers. An estimated 1.3 billion tonnes of food is wasted globally each year, one third of all food



produced for human consumption, according to the Food and Agriculture Organization (FAO) of the United Nations. **The amount of food lost or wasted costs 2.6 trillion USD annually and is more than enough to feed all the 815 million hungry people in the world - four times over.** At the same time we are worried that we don't have enough food for the growing population.

To address the problem, various enterprises are mushrooming globally. Misfits in USA and GRIM in Denmark are two such enterprises. They often work with dedicated farms and wholesalers. The advantage of such services or intervention saves money as they source high quality fruits and vegetables that stores can't or won't sell, stop food waste going to landfill simply because they don't look good and help farms find a market for the things they grow.

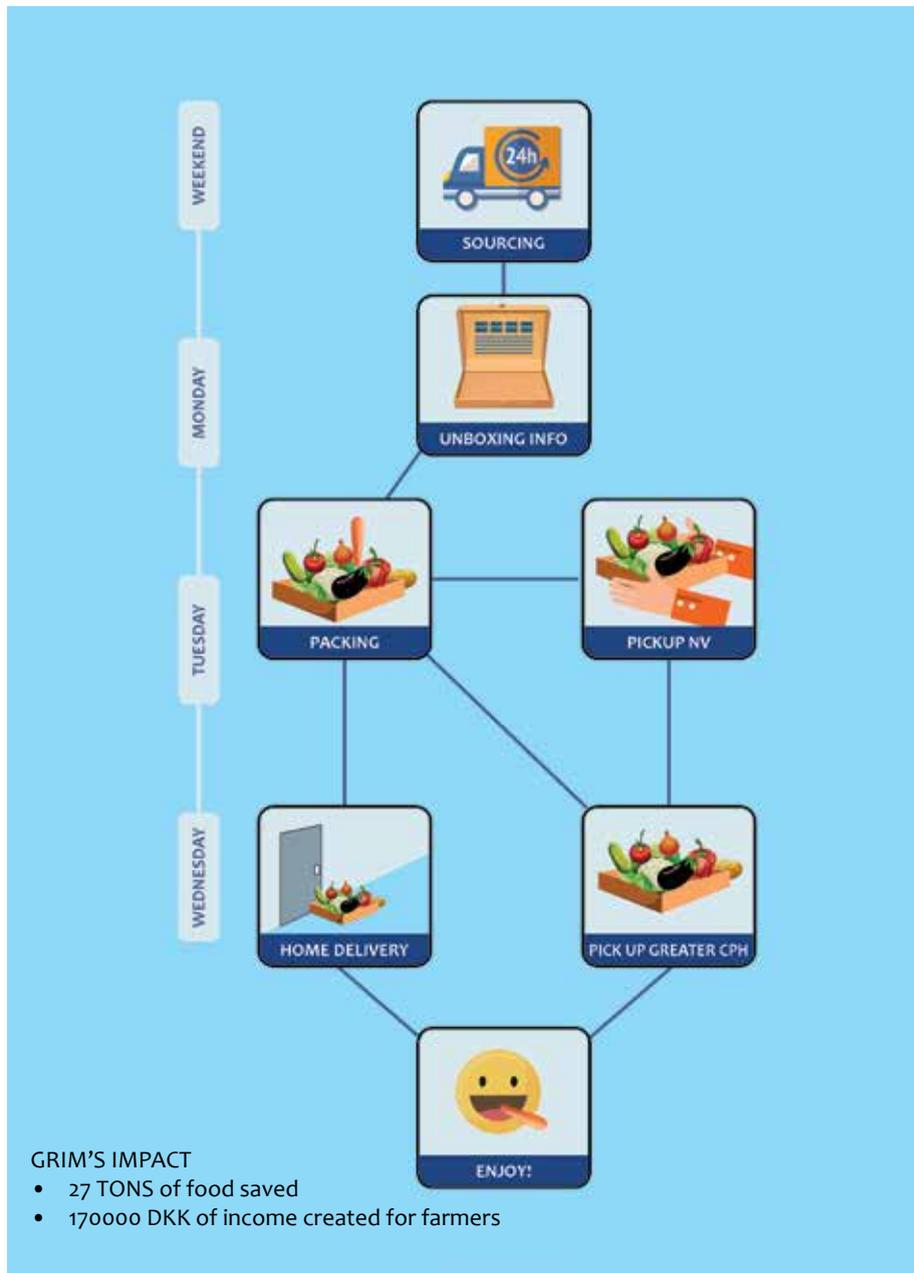


“Food waste” and “food loss” are commonly used terms but don't quite mean the same thing.

1. *“Food loss” typically refers to food lost in earlier stages of production such as harvest, storage and transportation.*
2. *“Food waste” refers to items that are fit for human consumption but thrown away, often at supermarkets or by consumers.*
3. *Agriculture emits 35% of all greenhouse gas (GHG) emissions.*

(Food and Agriculture Organization of the United Nations (FAO), 2011a).

Lesson Plan 3



Developed and adapted from the information available on <https://www.eatgrim.dk/>

Video available at, Exploring Ugly Food at GRIM: https://www.youtube.com/watch?v=Ilk51SiY_Xo
 The video is about GRIM, Denmark's first fruit and veg box delivery service that offers imperfect-looking and surplus produce to the customers. Thereby saving tonnes of food from getting wasted <https://www.misfitsmarket.com/> and <https://www.eatgrim.dk/>

Introduction

Biomimicry is an approach to transformation that looks for sustainable solutions to human challenges by mimicking the established as well as the evolving design of nature. This helps in creation and designing of the products that are built to last with a minimized impact on the environment.

With the progress in science and technology, humans have solved different problems but in turn have created sustainability challenges for future generations.

Importance of biomimicry

It is important that scientists and engineers look at the nature as their source of inspiration to get ideas in designing the products that are more efficient and nature friendly. Biomimicry definition states that nature influences innovation. The evolution of nature since earth was formed, has been one of the most complex process to establish a relationship between living and non living things. The nature has solved all the challenges between its living and non living entities through evolution. Thus biomimicry becomes an important approach to address challenges related to product design and sustainability.

Examples of biomimicry

1. When the bullet trains in Japan were being upgraded, there was a major technical snag regarding the noise of the train. They were just too loud. The design team determined that blunt front nose cap, was to be blamed.

To minimize the tunnel boom and increase overall aerodynamics they would



Source : https://upload.wikimedia.org/wikipedia/commons/e/ed/Bullet_train.jpg

SDG Linkages

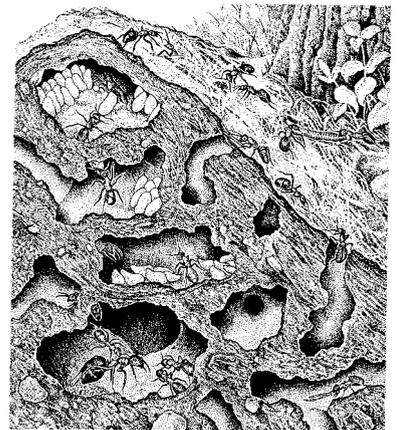


Lesson Plan 4

require a more streamlined nose. The engineers eventually modeled the next model after the beak of the Kingfisher bird as they have specialized beaks allowing them to dive into water to hunt while making a minimal splash.



2. Architects have been inspired from termites and constructed the Eastgate Centre Mall building using Biomimetic Architecture principles in Zimbabwe that self-regulates its internal temperatures, despite external temperature fluctuations. Like the soil termites build their mounds from, the building is built from construction materials with a high heat capacity, allowing them to hold and release heat like a buffer before the internal temperature changes.



Eastgate centre mall, Harare, Zimbabwe is inspired from Anthills

(Source: https://en.m.wikipedia.org/wiki/Eastgate_Centre,_Harare#/media/File%3AEastgate_Centre%2C_Harare%2C_Zimbabwe.jpg)

Classroom Activity: Inspiration from Nature

Learning Outcomes

Students will be able to

- describe the key design principles and strategies of natural systems that have inspired modern day innovations.

Time Required/Duration

90 minutes

Part 1: Classroom Activity – 45 minutes

Part 2: Outdoor Activity and discussion – 45 minutes

Resources required

- Cards with pictures of products inspired by nature (Group A- Product cards)
- Cards with source of inspiration for the product (Group B – Animal/Plant cards)



Procedure

Part 1:

- Divide the students into teams of six or eight members. Give Group A and B activity cards to each team so that there is one card per student.
- Explain to the students that they either have a product card or an animal or plant card.
- Ask them to look closely at their card and ask them to find someone with a card that they find some resemblance. For example, a student with a card having a Bullet train would try to find a match with a Kingfisher card and vice-versa.
- Once they have finished, ask each group to make a list of the special features of the design of the product and the animal or plant that has inspired those features.
- Provide a board or a space for each group to place the paired cards, and make a presentation to the class about their observations.
- Discuss with the class through the examples the concept of biomimicry in nature and how it has inspired design of various products and systems human beings use.

Part 2:

- Take the class outdoors and ask them to study venation in leaves.
- Discuss with them the role of veins in leaves to carry water and nutrition.
- Ask the students to think about similar systems of transporting materials in the human made world.

Assessment

- Ask the students to find at least 5 more products of daily use apart from the ones provided, which are inspired by nature.
- Ask the students how can the issue of waste can be dealt with learning from nature.
- Ask them to find out some examples that would not create waste.



Beehive



Aquatic leaf



Gecko



Burr



kingfisher



Bird

Biomimicry product



Water repellent material



Building



Bullet train



Drone



Climbing feet



Velcro

Open source images - Credits at the end

Impact of Products on Environment



Introduction

The production and consumption of a product has both visible and invisible environmental impact and it could be understood by going through the various materials/resources which are produced as an output at every stage of its lifecycle. This activity gives students an idea of how input-output analysis of the products in its life cycle can be useful to understand the overall impact or footprint of the product on earth and gives ideas to look for plausible alternatives. The input and output of the following stages of a product is analysed for investigating the environmental impact of a product:

1. Material extraction: where did the materials come from?
2. Product Manufacturing: what was the process of constructions /creating the product from raw materials
3. Packaging and transport (Product distribution): how the product is packaged and transported from manufacturing site to sale site
4. Product Use: what is the overall lifespan of the usage of the product? Does it requires energy to use?
5. Product End of life: how the product handled at the end of life? Is it disposal/ recyclable or/and reusable?

An improvement analysis or redesigning helps to reduce the overall impact on environment, i.e through conserving energy or water during any of the phases of the life cycle or exchanging materials for less hazardous waste ones.

Classrom Activity: Environmental Impact of Products

Most of the products that are used come through numerous processes. Each process has an impact on the environment. This activity will give detailed idea about the overall environmental impact caused by different products

Learning Outcome

Students will be able to

- analyse the various inputs and outputs at every stage of life cycle a product.
- can compare environmental impacts of different products.
- suggest ways to reduce the environmental impacts of products.

SDG Linkages



Resources Required

Each group (3 to 7 students) needs:

- Pencils
- Life Cycle flowchart
- 5 manufactured product to analyse. Each group to choose/allotted only one product having principal component or ingredient as paper, plastic, mixed textile, food, and water.
- Worksheets - Partially filled Flow chart depicted major stage of Life cycle of a product

Time Required/Duration

60 minutes

Procedure

- Discuss with the students the lifecycle flowchart of a simple product like pencil.
- Ask the students to think about the various input materials fed and output materials released/emitted at every stage of the life cycle in production of a pencil using the Annexure 5.1.
- Divide the class into 5 groups each having 3 to 7 members.
- Give each team a product on which to perform the input and output materials exercise. The products for analysis are a paper product, plastic product, textile product, food product, and a water product. All groups should have a separate product.
- Give the Input and Output analysis worksheet for detailing the lifecycle of the products (Annexure 5.1).
- Ask the students to follow the various stages in the lifecycle of the given product and fill the blank places of input and output.
- Ask the groups to share their individual list and analysis of input & output of the product with the rest of the class.
- List down the materials on board.
- Ask them to analyse and list, which all output materials go to landfill or back to biosphere.
- Discuss the impacts the products have on the environment in terms of the material emitted at each stage of its lifecycle. (attached in annexure 5.1)
- Have students think about modifications they might make to the life cycle of their products, so that impact to environment can be reduced.

Assessment

Ask students to present their suggested product improvements to reduce impact on the environment.

Facts and Figures

1. ENVIRONMENTAL IMPACT OF PAPER



discarded paper and paperboard make up roughly 26% of solid municipal solid waste in landfill sites.



Pulp and paper is the third largest industrial polluter to air, water, and land in both Canada and the United States, and releases well over 100 million kg of toxic pollution each year.



Worldwide consumption of paper has risen by 400% in the past 40 years, with 35% of harvested trees being used for paper manufacture.



Over 6.5 million trees were cut down to make 16 billion paper cups used by US consumers only for coffee in 2006, using 4 billion US gallons (15,000,000 m³) of water and resulting in 253 million pounds of waste. Overall, North Americans use 58% of all paper cups, amounting to 130 billion cups.



The pulp and paper industry is also associated with important emissions of heavy metals. In Canada, for example, this industry is the third source of lead (Pb) emissions to water



Discharges can also discolour the water leading to reduced aesthetics. This has happened with the Tarawera River in New Zealand which subsequently became known as the “black drain”.



Paper waste accounts for up to 40% of total waste in the United States, which adds up to 71.6 million tons of waste per year in the United States alone.



In 2006 the pulp and paper industry in Canada released about 60,000 tonnes of sulfur oxides (SO_x) into the atmosphere, accounting for just over 4% of the total SO_x emission from all Canadian industries.(Industry +SO_x)

2. ENVIRONMENTAL IMPACT OF PLASTICS



In 2010 approximately 275 million metric tonnes of plastic waste were generated by 192 countries, with 4.8 to 12.7 million metric tonnes entering the ocean.



Over 700 million metric tonnes of plastic fibres have been produced and washing a single garment releases more than 1900 individual fibres into our rivers and oceans.



“In the United States, probably 70 or 75 percent of the plastic water bottles that we buy and consume are never recycled.



As of 2010 an estimated 11.1 billion items of plastic are thought to be in the Asia-Pacific region alone and this is expected to increase to 15.7 billion by 2025.



At the time of writing over 700 different species have been documented to have had some form of negative interaction with marine litter (namely plastics).



Ghost gear is likely to be one of the most significant threats in marine ecosystems and over 46% of plastics found in the ‘floating garbage patches’ (or gyres) are made up of this plastic type.



The additive effects of climate change and other stressors (like plastic pollution) are unknown.



Macroplastics impact reefs by:
1) Direct physical, mechanical damage
2) The introduction of pathogenic agents ‘hitchhiking’ on the plastics
3) ‘Overtopping’ phototrophic animals preventing light from reaching tissue and creating low oxygen levels
4) Direct ingestion and gut blockage
5) Entanglement and entrapment.

3. Environmental Impact of Clothes



Each year, over two billion t-shirts are sold worldwide and 520 million pairs of jeans are sold in the U.S. With the production of one t-shirt using up 700 gallons of water and one pair of jeans using up 1,500 gallons, it is easy to understand why the call to curb textile waste is urgent.



A Levi's plant in El Paso, TX uses 15% of the city's water supply. In a study by Levi's, researchers found that manufacturing one pair of jeans requires 400 mega joules of energy, and expels 71 pounds of carbon dioxide. The amount of carbon dioxide emitted to produce one pair of



jeans is equivalent to driving 78 miles.

The cotton industry uses 25% of the world's pesticides and herbicides.

A fading agent called potassium permanganate, starch, and indigo dye waste are often released into the same canals used to irrigate local farms. These chemicals sterilize soil and kill seedlings.



The Environmental Protection Agency estimates that the average American throws away about 70 pounds of clothes a year, most of which are destined to rot away in landfills.

4. Environmental Impact of Water



Pumping 17,000 ft³ (480 m³) of water a height of 330 ft (100 m) requires approximately 200 kilowatt-hours of electricity (learn more). In many major municipal areas water is pumped hundreds of miles from its source before it is used.

In an average home, heating water accounts for 15% of the total household energy use (learn more). Nearly 30% of all indoor water use is hot water.



Hot water is used for dishwashing, clothes washing, showers, baths, faucets, hot tubs and cleaning. Running hot water out of a faucet for five minutes is equal to the amount of energy it takes to burn a 60W incandescent bulb for 14 hours.

After water goes down the drain it flows into the sewer to be treated at a wastewater treatment plant. Energy is

used in pumping water to the wastewater treatment plant and in treating it with aeration and filtration. For example, in California it takes approximately

475-1,400 kWh of energy to treat 300,000 gallons of waste water ([learn more](#)).

5. Environmental Impact of Food



consuming 11.5 billion sandwiches annually in the UK generates, on average, 9.5 million tonnes of CO₂ eq., equivalent to the annual use of 8.6 million cars

Then there is the packaging material which comes in at up to 8.5 % and, finally, transporting materials and refrigerating sandwiches themselves adds a further 4%.

Input and Output Analysis Worksheet

Inputs	Process	Outputs
<p>Materials</p> <p>Wood Graphite Glue Paint Rubber Plastic</p>	<p>Products Design</p> 	<p>Principal Products</p> <p>Pencil</p>
<p>Energy</p> <p>Fuel used to source and distribute material – transport Electricity used in manufacturing Energy used in extraction of material Human energy used while manufacturing</p>	<p>Materials Extraction / Processing / Sourcing</p> <p>Wood, Water, Space, Graphite, Machines that use different materials</p>	<p>Co-products</p> <p>Packaging material</p>
<p>Water</p> <p>For growing trees - wood For processing and manufacturing</p>	<p>Product Manufacturing</p> <p>Energy, machines, Paint (Different chemicals), water for cleaning</p>	<p>Air Emissions</p> <p>Different gases due to burning of fuels and fumes from chemicals/ solvents used</p>
<p>Air</p> <p>Oxygen used for burning</p>	<p>Product Use</p> <p>Sharpener, paper, human energy</p>	<p>Solid Waste</p> <p>Graphite waste, wood waste, packaging material waste, chemicals fuel to get energy</p>

	<p>Product End-of-Life Wood shaving, pencil lead</p>	<p>Water Effluents Water due to extraction, processing and also cleaning</p>
		<p>Other Environmental Impact Land degradation Wood</p>

Sources :

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<https://ecologycenter.org/plastics/ptf/report3/>

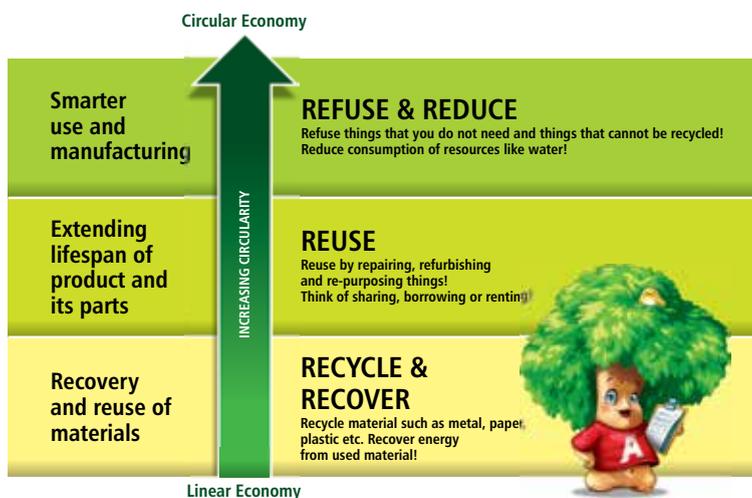
<https://www.earth.com/news/sandwiches-environmental-impact/>

Circularity in my Backyard



Introduction

Earth has a finite amount of resources. Every resource we use leaves a footprint on the planet and it requires a certain amount of time to replenish the particular resource. The most important things like food, water, clothes, paper etc. are sourced from natural products and it is therefore important to use these resources judiciously. When we try to extract the maximum practical benefits from natural products, it is important that we use them appropriately to ensure that there is no wastage and there is minimum impact on the environment.



Adapted from Potting, J.; Hekkert, M.; Worrell, E.; Hanemaaijer, A. Circular Economy: Measuring Innovation in the Policy Report; PBL Netherlands Environmental Assessment Agency: The Hague, The Netherlands, 2017.

Over-extraction of resources for the benefit of a few has an impact on communities who require them the most. For example, mining for precious metals which are a component in mobile phones not only has an impact on the natural environment where it takes place but also on people who are living around the area, and those who work there. Social impacts of a wasteful lifestyle are felt most by the poor communities who may or may not even be in the same place, country or region.

Classroom Activity: Resources we use

This lesson plan will help students apply the principles of Circular Economy through a reflection of resources they use, the waste that is created, and the social impact it has in the school. It looks at providing a hands-on experience to students in data collection through surveys. It also encourages students to interpret and represent the data. The learning processes include hands on engagement, classroom interaction, group work, analysis of responses and eventually change the way they use resources.

SDG Linkages



Learning Outcomes

Students will be able to

- identify how their consumption has an impact on resources.
- find out how life of resources can be extended.
- make better choices before using resources.

Time Required/ Duration

60 Minutes

Part 1: Classification of different objects - 30 Minutes

Part 2: Activity - 30 Minutes

Resources required

Student writing material including notebooks and pen

Procedure

- Ask the students to make an individual list of all the things they use daily. The list should include everything including food, paper napkins, plates, notebooks, clothes, pencil, etc.
- Ask the students to find out the raw materials of the products, sources of those raw materials and tabulate them in a single sheet.
- The products can be listed in the form of a table given below. An example of a pencil is provided.

Sr No.	Product	Raw Material	Source
1	Pencil	Wood	Trees

- The students have to write at least 10 items and their sources.
- Make groups of 4-5 students each and ask them to list the 5 most common items they found in their group.
- Discuss about all the items mentioned by each group and their sources.
- Ask the groups how often they use the item and note it down in their list.

Home Assignment

- Ask the groups to do further research and find out how much time does it take to naturally replenish the sources of the products in their list. This will make them understand the impact of items on the environment.

Product	Source	Time taken to replenish

Ask the groups to write down what happens to those items after use. Which possible places do these items end up in?

Assessment

While they are analysing the environmental impact ask them to also reflect on the impact of these items on society. They could discuss about its impact during extraction, production, use and disposal. They could also discuss about the amount of financial resources that can be saved in case alternative options are used.

Introduction

School is a system that sees inflow and outflow of materials as products and services to meet the needs and also sees outflows of materials during the process of consumption and after consumption. For example, books, stationary etc., are the materials which are used to conduct teaching and the waste generated, water used etc., would count as materials that are consumed.

In this activity the students will conduct an environmental review of their school to find out the Circular Economy compliance status of their school through gap analysis by using the developed rubric (Annexure 7.1). Based on their findings, students will come up with their own action plans aimed at increasing their Circular Economy compliant scores in different areas.

Classroom Activity

It is important that circularity is followed in school as well. This activity will ensure the circular economy compliant status of the school.

Learning Outcomes

Students will be able to

- identify the key design strategies for
 - low waste generating material and processes - increasing efficiency by closing, slowing and narrowing the resource flows in production, distribution and consumption processes.
 - extracting economical value and usefulness of materials as resource in the entire cycle of consumption and production - increasing longevity and recyclability
 - decreasing the need of number of products through - renting and sharing to cut on idling of resources.
- analyse the present compliant status of the school using a set of criteria.
- evaluate the status of the school using a set of criteria.
- design a better circular consumption system in school.
- list strategies to increase the circularity of materials in the school.
- develop a proposal and set of indicators to promote circular economy approach across various sectors of the school.

Time Required/Duration

Part 1: Two 60 minute class period for analysis of the rubric, gap analysis and prepare the action plan/proposal.

Part 2: Approximately 30 days for students to complete action plan. Much of the student work will be completed outside the classroom.

Resources Required (for each group)

- Printouts /Photocopies of the Circular Economy compliant rubric for schools
- Presentation materials (projector, overhead, whiteboard)
- Copies of the action project/proposal format
- Internet access for research

SDG Linkages



Activity 1



Classroom Activity 1: Assess Circular Economy Compliance

- Introduce the rubric to students and explain that this tool will allow them to assess compliance to circular economy.
- Assign different material flows to group of students.
- Provide each group of students with a printed copy of the rubric. Give them 10 minutes to review the assessment criteria of each of the consumption areas.
- Ask students to choose a consumption flow to review over a week. Ensure that all major flows are chosen
- Ask them to discuss the status based on their observations
- Once students are done with their initial explorations, ask them to briefly share their observations in groups in the next class on
 - what kind of gaps they have noticed in each area of consumption?
 - which of the findings surprise them the most?
 - were there any resource consumption areas, that they would have wanted more information on?
- Ask the students to present their learnings.
- Ask them to use the the rubric as an inspiration to come up with an action plan to increase their score in the selected areas of resource consumption. (Use Annexure 8.1)

Home Assignment

- Give them a week to develop a proposal/action using the template to work on for next 30-60 days. They have to develop a proposal in the specified format to suggest actions to be taken to address issues using the Circular Economy approach the selected area of resource consumption. The action plan can have technological/infrastructure inputs, system/policy changes along with main component of behavioural change to achieve the desired scores.
- Encourage them to do their own research to form their own ideas on how they can increase the score of Circular Economy compliance in the selected area of resource consumption and how to measure the impact. To guide students through this process, provide them with the following instructions. The proposal should:
 - explain why it is important to increase the Circular Economy score in the selected area of resource consumption.
 - find out which factors or human actions contribute to the overall I impact in their selected area.
 - evaluate possible actions that can increase the Circular Economy compliance in their selected area that they can implement in their everyday lives.

- measurement - think about how the effectiveness of their actions can be quantified. Then, specify how often they would need to take these measurements.
- come up with a concrete action plan in terms of a proposal to implement their idea and measure its effectiveness.
- Collect the proposals from each group of students and do a quick feasibility check on their actions, in terms of feasibility of proposed actions if they can actually be implemented and tested. Ask the Eco-Committee to evaluate the actions.

Notes for Teachers

The impact measurement could be a bit tough for students. Some examples on kinds of measurements they can do to quantify the impact of their proposals are:

- number of bags/pounds of trash/waste per day.
- gallons / liters of water used per day (look at water meter).
- hours per day certain water-using appliances have been in use (shower, dishwasher, washing machine, faucets, etc.). It might be helpful for students to do some research on how much water certain appliances use per hour or day, so they can make their own water usage calculations.
- number, weight, or volume of certain food items that have been thrown out per day.
- quantity of other consumables that have been thrown out per day (plastic bottles, plastic bags, clothes, toys, etc.).
- kilowatt hours of energy used per day (look at electricity meter).
- hours per day certain electrical appliances have been in use (TV, heating/cooling, dishwasher, lights, washing machine, etc.). It might be helpful for students to do some research on how much electricity certain appliances use per hour or day, so they can make their own energy usage calculations.

A framework rubric to assess a Circular Economy (CE) Compliant School

Part A

The framework guides to assess the Level of Circularity in an Eco-School.

Area of Intervention	Performance Indicator				Record findings
	High (A)	Medium (B)	Low (C)	None (D)	
1) Circular Economy Education	a. Teaching and Learning projects that support circular economy	School has integrated circular economy in the curriculum by mapping curriculum and students take up projects to Advance Circular Economy	Circular Economy Education is given through special sessions and events are organised.	Only events are organised	
2) Students Knowledge - Essential Learnings in Circular Economy	a. Linear, Recycling and circular economy	Students are able to differentiate between the levels of circularity	Students are able to define the three terms	Students demonstrate some knowledge of the concepts	
	b. Technological and Biological resources	Classify resources	Explain and give examples of technological resources	Only provide some explanation	
	c. 9 R Decision Matrix	Can explain the hierarchy and rationale of some of the hierarchy	Knows some the important desirable actions and non-desirable Rs	Recalls some of the Rs	



Lesson Plan 7

	d. Principles of circular economy	Can explain the principles on which circular economy is related to material, energy, zero waste	Recall some principles	Only relate it to cycles	
	e. Examples of products and services based on levels of circularity	List at least 5 examples	Knows at least 3 products/services		
3) Students Competencies	a. Strategies for advancing circular economy	Can identify ways to increase circularity	Knows some ways but cannot give specific examples	Knows it broadly	
4) Students Disposition	a. Actively participates in circular economy events	Proactively volunteers to organise and contribute in circular economy events	Is only a participant	Visits the event	
5) Behaviours and Participation	a. Take Actions	Buys/use products based on circular economy	Support and convinces parents and peers to use products that help advance circular economy	Is aware of products	
	b. Raise awareness	Frequently talks about circular economy and points out changes that can be made	Talks about products in general to support circular economy	Sometimes speaks about the need for circular economy	

Part B

Environmental Impact on Resources

Area of Intervention	Performance Indicator	Level of Performance			findings
		High (A)	Medium (B)	Low (C)	
6) Food	a. Organic	All Organic products	Some of the products are organic	Sourcing organic is low on criteria	
	b. Vegetarian	Only Vegan/vegetarian	Vegetarian or vegan is preferred policy	No policy but efforts are made to reduce meat	
	c. Packaging of Material	All vegetables, fruits and breads with no packaging	Mostly paper packaging	Single use Plastic packaged	
	d. Sourcing	Almost all Locally from nearby places	Mostly Locally but some from distance	Only some products are sourced locally	
	e. Food Waste	Not at all	There is some food waste but less than 20 percent	More than 30 percent of the food is wasted	
	7) Water	a. Packaging	Tap water is good for drinking	Large dispenser or treatment	Single use packaging and bottles
b. Re use of Grey water		Grey water is recycled or reused within the campus	Some grey water is reused	Plans are there but looking for funds	
c. Water saving devices		Water saving devices are installed at all points	Some water saving devices are installed where the usage is heavy	Very few water saving devices and measures	



Lesson Plan 7

	d. Water harvesting	A system is place to actively capture water	Done naturally as part of water shed	Plans are there but looking for funds	
8) Greening	a. Trees on the Campus	More than 80 percent of the available space is green	50 to 80 percent of the spaces are green	Less than 50 but more than 20 percent of the space is green	
	b. The leaves etc are left on the grounds	All leaves are left to naturally degrade and recycle	Picked and treated within the campus	Collected and sent outside the campus for disposal	
9) Waste management	a. Composting	Installed system in campus for 100 percent composting	Only around 50 percent of green waste is composted	Plans are there but looking for funds	
	b. Collection and Segregation of Waste	100 percent segregation as per the systems in the country	Segregation in two broad categories – green and other wastes	Collection done but only in one bin for all wastes	
	c. Recycling	100 percent of the waste is recycled	Only recycling of waste that gives economic value	Waste is given to the collector	
10) Paper	a. Sources recycled paper	100 percent of papers used is recycled	Around 50 percent of the paper is from recycled material	Efforts are made but no active policy	
	b. Sustainable sourcing	Papers that have sustainability labels like – FSC, Recycling are sourced	Wood free, chlorine free paper is used.	Efforts are made but no active policy	

11) Transport	a. Walk or bike	More than 80 percent students	More than 50 percent	Less than 50 percent but more than 30 percent	
	b. Shared transport—trains, buses, car pooling	Encouraged actively by school	Students are explained the advantage	Efforts are made but no active policy	
	c. Rented or owned	The automobiles are leased/rented/shared	Efforts are made to ensure that the automobiles do not stand idle	Efforts are made but no active policy	
12) Computers, peripherals and other Consumables	a. Repair or refurbish	Products that can be repaired and refurbished are only bought.	To an extent products that can be repaired and refurbished bought.	Efforts are made but no active policy	
	b. Reusable/refillable	Only multiple use materials like ink cartridges, pens etc	Some multiple use materials like ink cartridges, pens etc	Efforts are made but no active policy	
	c. Long life	The years the product will last is a critical decision making criteria	The numbers of years the product will last is one of the criteria but is the not a primary one	Efforts are made but only for costly products	
	d. Exchange and other Consumables	The products that can be exchanged back are bought or taken on lease.	To an extent but only if the products gets obsolete.	Efforts are made but only for costly products	

Introduction

It is important that awareness and education for circular economy leads to action. The practical aspect of circular economy should be quantifiable in terms of tangible outcomes, so that action is visible. Armed with knowledge and understanding of various dimensions of circular economy and how thinking circular can help sustainability, the students need to think in a circular manner to make sure that their consumption reflects in their choices. This lesson plan will help them in assessing the resources that they use and the position of their school in terms of circular consumption. It will also act as a tool to make changes in the current consumption practice of the school.

Classroom Activity

After validation of the action plan, ask the students to implement the proposal. First, however, they will have to measure what their baseline score is before implementing their proposed actions, in order to be able to measure its effectiveness. To do this, students will use the rubric tool to assess their school's choices in their selected area of resource consumption. Give them around 1 week to do the baseline. They can enter the data in the rubric as baseline with date of the assessment.

Following the first week of baseline and noting down the scores, let them implement their action project as proposed. The group should continue to monitor and measure their impact for another week with their action implemented using the same rubric as before. Again, they should enter all their data into the same spreadsheet to find out how their impact changes in the second week. This can be continued as per the time/weeks proposed for implementing the proposal.

After 2-4 weeks of implementation, ask students to prepare a 2–3 minute slideshow about their project. They should present their data on the basis of their findings and also discuss with other groups the impact their action had.

Classroom Reflection

Encourage students to reflect on the following based on the experience they had while implementing the action project:

1. What new things did you learn about Circular Economy approach in your selected areas of resource consumption from this action project?
2. Which actions did you find worked best and had more impact?
3. Which proposed actions did not work that well?
4. Why some actions were more effective than others?
5. In what ways did this action project have an impact on your community?
6. What would you do differently if you were to do this action project again?

Summing up

Calculate the collective positive impact your class made after implementing all of their action plans. Use the scoring sheet given in Annexure 8.1. Use the individual area data sheet to combine the result of the entire class.

Annexure 8.1

Scoring Sheet

Level of Performance	Counts as per rubric	Multiplying Factor	Total
High (A)		5	
Medium (B)		3	
Low (C)		1	
None (D)		0	
		Grand Total	

Score Range	You are a
More than 150	E-SPACE Champion School
100-150	E-SPACE Aspirational School
75-99	E-SPACE Startup School
Less than 75	E-SPACE Planner School

Areas of Improvement

Improvement Area	Suggested Actions

Role of Eco-Committee

The **Eco-Committee** has an important part of Ecoschools Programme. The **Eco-Committee** is responsible for carrying out the initial and subsequent Environmental Reviews and for preparing an Action Plan for the whole school to engage in.

- Leading the Eco-Schools program
- Representing the whole school and wider community interests
- Ensuring that the entire school knows about Eco-Schools and will receive regular updates
- Developing, implementing and monitoring the school's Eco-Action Plan that addresses the environmental concerns of the school community
- Taking the lead in carrying out the initial and subsequent Environmental Reviews (Step 2 of the Eco-Schools Methodology)
- Ensuring that all members of the school community (especially pupils) are represented in the decision-making process
- Providing a link between pupils, teachers, senior management and the entire school community and, ideally, the Local Community, integrating the program within the School Development Plan.

The Design Challenge!

Make it better - Design for Circular Economy!



Introduction

A true circular economy is when materials and objects are continuously used or remade without any loss of quality or are efficiently returned to the biosphere.

Reuse, repurpose or modify are terms used in an area where urgent action needs to be taken if we are to succeed in fulfilling the aim of the circular economy. Under this concept, the lifetime of materials is extended and we continue to exploit the benefits and properties of those materials.

As we move towards Advancing Circular Economy, the solution often lies in the design! As per WRAP, around 80 percent of a product's environmental impact is locked in at the design stage. The design stage decides how the product will be produced, using what material, packaging, distances it will travel, how it will be consumed and disposed.

Nature has produced the best design to inspire us and learn from. If you look around, the unnecessary 'value additions' in many of the products and services have created the problem. In a market economy, it is thinking consumers who make the change! A single tweet with a photo of the whole oranges, devoid of their skin and placed in plastic packaging, went viral after the poster commented on the irony of removing their natural protective layer and increasing the waste. There are various strategies by which we can boost circularity. The key principle is to look at the Life Cycle of a product or service and Design the Life Cycle for Low Waste through the 9R's strategy of decision making.

The waste can be eliminated by

1. Looking at low-impact materials and processes used for production – Minimize waste.
2. Increase the life span of the product by designing for longevity
3. Design for recyclability

You can ask students to look case studies collected by Ellen MacArthur Foundation for inspiration

<https://www.ellenmacarthurfoundation.org/case-studies> given at the back cover of the publication.

SDG Linkages



The ReSOLVE (Regenerate, Share, Optimise, Loop, Virtualise, Exchange) framework for Circular Economy by McKinsey Center for Business and Environment.

Regenerate	<ul style="list-style-type: none"> • Shift to renewable energy and material • Reclaim, retain, and restore the health of ecosystems • Return recovered biological resources to the biosphere
Share	<ul style="list-style-type: none"> • Share assets – cars, room, • Reuse/pre-owned • Repair and maintenance • Design for durability and upgradability
Optimise	<ul style="list-style-type: none"> • Increase the performance/efficiency of the product • Remove waste in production and supply chain • Leverage big data, automation, remote sensing and steering
Loop	<ul style="list-style-type: none"> • Remanufacture products or components • Recycle material • Digest anaerobically • Extract biochemical from organic waste
Virtualise	<ul style="list-style-type: none"> • Book music, travel, online shopping, autonomous vehicle
Exchange	<ul style="list-style-type: none"> • Replace old with advanced not – a renewable material • New technologies • Choose new products/service (e.g. multimodel transportation)

Classroom Activity 1: Exploring Waste and Design Link

Learning Outcomes

Students will be able to

- understand that all objects start with a design
- explore the link between waste and design

Time Required/Duration

60 Minutes

Resources Required

- Animation film ‘Imagine a chair’ on youtube <https://www.youtube.com/watch?v=FKjJyus6WOg>
- Resource sheet ‘Future designers’
- A collection of objects that we use every day: mobile phone, iPad, book, football, watch etc.
- One torch for each team

Procedure

- Discuss how all objects start with someone designing them with inspiration from nature. Discussed the things Designers have to think about such as, shapes, materials, colors, functions, energy use, durability, smells and sounds.
- In teams, investigate the design of a particular object (e.g. a torch) by dismantling it.
- Ask students –
 - What is it for? What materials are used? How is it powered? What happens when it is broken? Could it be repaired and reused? In your view, is it a good or bad design and why?
- Show the animation film 'Imagine a chair' and explore how objects such as torches could be designed differently to get rid of waste. Could broken parts be repaired? Could material be recovered and used again?

Assessment

Did the design idea solve the problem statement that you wrote above? Do you think it is the best solution possible?

Do you think that if you started over, and incorporated what you learned from your first design, you would be able to think of an improved design?

What would be different?

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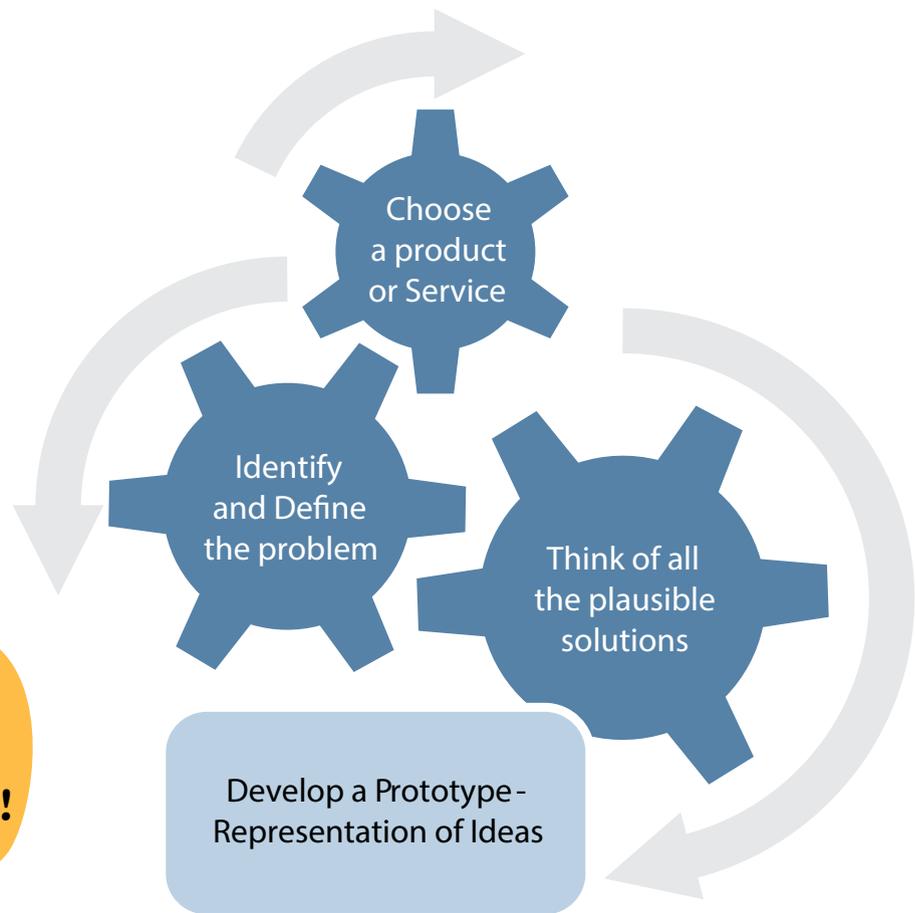
<https://earthbound.report/2016/09/12/the-resolve-framework-for-a-circular-economy/>

The PACE Challenge - Design a product that lasts?

Redesign any product or Service for Advancing Circular Economy.

School Name: _____

Date: _____



**Test the Idea
and Present it
on the PACE Day!**

Future designers: Keep in mind

1. Use few simple materials (Mixed materials such as in juice cartons are tricky to recover. These are made of layers of cardboard and plastic).
2. Choose materials that can either be composted (so no harmful chemicals) or that can be reused to make something else.
3. Think about materials that can be used a number of times for different things before being returned to the soil (e.g. trees to furniture to chipboard to paper to soil).
4. Think about what happens to the product at the end of its life.
5. Think about how your product can be easily taken apart so materials can be recovered quickly and cheaply.
6. Design for easy repair so parts can be replaced or upgraded.
7. Think about whether your product should be rented or bought (e.g. Is it worth buying a something that will only be used for a few days a year?)

Resources available on the following websites were used to develop the publication.

- <http://www.vestaeducation.com/viu-education-program/environmental-impact-study-lesson-plan>
- <https://www.ellenmacarthurfoundation.org/assets/downloads/schools-colleges/Schools-Colleges-WLL-Lesson-Plan-2-V2.pdf>
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- <https://earthbound.report/2016/09/12/the-resolve-framework-for-a-circular-economy/>

About us



LUCART, is a leading company in Europe in the production of MG paper, tissue products (paper items for daily use such as toilet paper, kitchen paper, napkins, tablecloths, handkerchiefs etc.) and air laid products, was founded in 1953 by the Pasquini Family.

Website - <https://www.lucartprofessional.com>



The Eco-Schools programme of Foundation for Environmental Education has developed from a European educational programme to a global model for Environmental Education and Education for Sustainable Development. Eco-Schools was developed as a response to the needs identified at the Earth Summit held in 1992 at Rio and articulated in the Agenda 21 where education, raising of public awareness and training, were identified as key drivers and critical to the promotion of sustainable development and improving the capacity of people to address environment and development issues. Over the years the programme has grown to have an outreach of more than 52000 schools in 68 countries that engage 19 million students who are supported by 1.4 million teachers.

The programme aims at providing every child with the opportunity to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future by integrating priority sustainable development issues into teaching and learning.

Website - www.ecoschools.global

Decision making through 9R!

- 01 Refuse
- 02 Reduce
- 03 Reuse
- 04 Repair
- 05 Refurbish
- 06 Remanufacture
- 07 Repurpose
- 08 Recycle
- 09 Recover

Adapted from Potting, J.; Hekkert, M.; Worrell, E.; Hanemaaijer, A. Circular Economy: Measuring Innovation in the Policy Report; PBL Netherlands Environmental Assessment Agency: The Hague, The Netherlands, 2017.

“If it can’t be reduced, reused, repaired, rebuilt, refurbished, refinished, resold, recycled or composted, then it should be restricted, redesigned or removed from production.”

— Pete Seeger

Foundation for Environmental Education (FEE)

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