



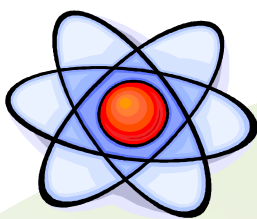
Technology Education Key Learning Area

Case Study: Students should be made aware of the relevance of the technology they are studying to the real world. Case studies on technology and design enable students to put their learning into an authentic context.

Authentic Context: Students could understand the issues of Green design, Green Technology and Green Enterprise in response to environmental issues through an example, namely energy saving lightings.

Level: S3

Knowledge Context Covered: Common Topic – Technology & Society (Environmental issues)



3G: Green Design, Green Technology and Green Enterprise



Author

Mr Li Yu-wai

Head of Department (Design and Technology)

Tang Shiu Kin Victoria Government Secondary School

Project Coordinators

Mr Li Yat-chuen

Senior Training Consultant

Institute of Professional Education And Knowledge, VTC

Mr Tsang Siu-wah, Ephraim

Training Consultant

Institute of Professional Education And Knowledge, VTC

The copyright of the materials in this Case Study belongs to the Education Bureau of the Government of the Hong Kong Special Administrative Region.

Duplication of materials in this Case Study may be used freely for non-profit making educational purposes only. In all cases, proper acknowledgements should be made. Otherwise, all rights are reserved, and no part of these materials may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior permission of the Education Bureau of the Government of the Hong Kong Special Administrative Region.

© Copyright 2010

Note by the Institute of Professional Education And Knowledge, VTC:

Every effort has been made to trace the copyright for the photographs and images in this Case Study as needed. We apologize for any accidental infringement and shall be pleased to come to a suitable arrangement with the rightful owner if such accidental infringement occurs.



Background

Since the Industrial revolution, human beings are producing more CO₂ and other greenhouse gases. This causes the global temperature to rise and induces global climate change, melting of icebergs in poles, and rising of sea water level. All these are caused by the greenhouse effect. This becomes the most concerned topic of the world. “It also changes the world enterprise operation,” said by Sigmar Gabriel, the commissioner of environment, Germany Government.



An enterprise consultancy firm, Accenture, reported in 2008 that over 64% consumers would be willing to pay 11% more in average to buy less greenhouse gases emission products and service, 89% consumer had changed their habit and were willing to buy products that were more environmental friendly and with low energy consumption.

The two extracts above have stated that more and more people are concerning the climate change and the global warming effect. They have more concern about environmental issues when making their buying decision. Worldwide enterprises are market-driven and become more environmental conscious. Therefore, enterprises need to make more environmental pledge and action to build brand images, products and service more Green.



The Story



What is Green Design?

Green design is driven by the consumers' awareness of environmental-friendliness, it is also known as "Design for Environment" or "Sustainable Design". It does not only apply to consumer products, it also applies to Green Architect. By the help of emerging materials technology, designers can now make products that are more environmental friendly to the ecosystem. Green design is also viewed as a corporate responsibility to the society. Basically, the definition of Green design can be known as designing a product of low energy consumption, less packaging, less harmful substances, less weight, recyclable, longer lifetime and more reliable. Some people consider that a good design is also a Green design. If a product has no market value, no user wants to buy it, it turns out to be rubbish, it is also not environmental friendly.

Examples of Green Design

The design of vacuum cleaner with no filter bags inside can be regarded as a Green design as it produces less rubbish – the "used filter bags" after its service lifetime. Some vacuum cleaners use reusable filter bags that may reduce the number of filter bags to be deposited. However, the cleaning of reusable filter bags wastes a lot of water that is not environmental friendly. It poses also hygienic problem if the reusable filter bags are not cleaned properly and regularly. A product that can be easily dissembled and recycled is also regarded as a Green design. Some TV manufacturer claim that their TV products are also Green design with less number of screws to be used and easy dismantled parts. The ease of dismantle can facilitate recycle by reducing the labour and cost involved in the recycling process.



http://i.i.com.com/cnwk.1d/i/bto/20080107/ECOTV_270x276.gif



Conflicts of Green Design

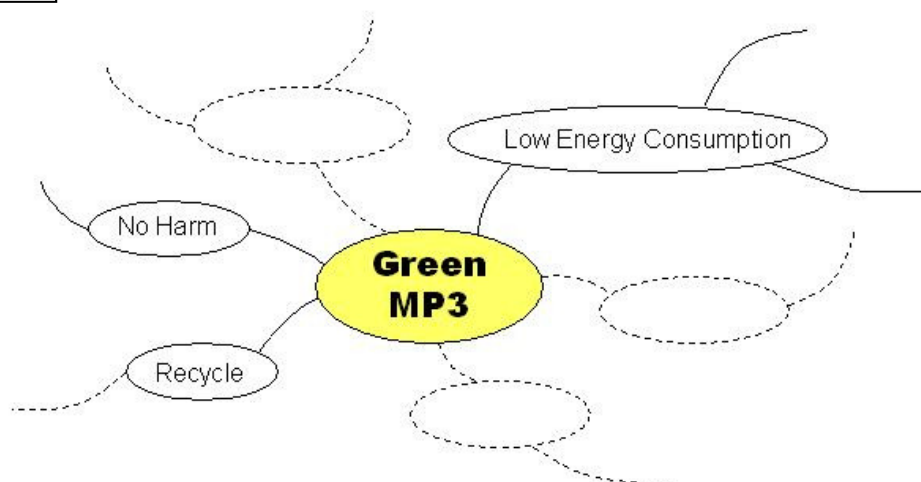
To some enterprises, it is not easy for them to make Green design. Take computer manufacturing companies as an example. If they design a computer of low energy consumption, the processing speed of CPU must be lowered and it may not be able to meet the requirements of users. If the company uses no-lead substitute components, the materials cost will be very high. If the recycle rate is increased, the labor cost of dismantling and classifying the used products into reusable and recycling parts will lower their sale profit.

Class Activity One

- You are a group of product designers. Use a Concept Map to present the ideas of Green MP3.
- You have only 5 minutes to complete your tasks and then share your ideas to your classmates.



For group use





What is Green Enterprise?

Green enterprise is not only referring to the businesses in the recycling spots. It applies to an enterprise that has an overall environmental-friendly policy in developing their products. The key concerns are: (1) Low energy consumption; (2) No harm; and (3) Recycle.

Sony has launched a notebook computer of eco-conscious features. It uses the recycled materials for packaging and no-lead components. It has a rechargeable battery recycle plan for the users. The slim design itself can minimize the use of natural resources and the case is made of easy-to-recycle materials. The Green policy of Sony is that it promises to donate one percent of each notebook price to non-profit environmental organizations. The company is also offering rebates to consumers who trade in their used PCs for recycling.

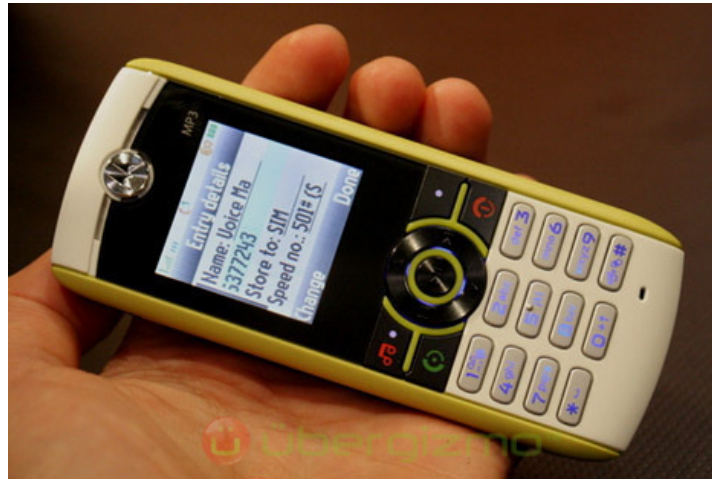


<http://www.circuitcity.com/IMAGE/product/enlarged600/son/PC.SON.VGNFW140EH.CN.JPG>

Recycling Scheme by Green Enterprise

Many international enterprises have launched their used products recycling scheme to promote recycling rate. Most of them have very definite strategy for recycling. Motorola has launched a new phone that includes a recycling pre-paid envelope in the packaging. When the consumers no longer use the current phone (or previous phones), they can mail back the phone to Motorola by using the envelope for recycling.

The picture below is a carbon free certified mobile phone. It is made of plastics coming from recycled water bottles. The plastic parts of this phone are also recyclable. The packaging uses 100 percent recycled paper and vegetable ink. Vegetable based ink or vegetable ink is a kind of environment friendly ink which is made from vegetable oil. The basic solvent of vegetable ink is made from different varieties of vegetable oils instead of petroleum. This will greatly reduce the amount of VOCs (volatile organic compounds) emitting into the atmosphere. It takes a bit longer to dry as compared to other petroleum ink.



http://www.ubergizmo.com/15/archives/2009/01/moto_w233_renew_green_phone.html

Laws governing the electrical and electronic waste

In 2005, Restriction of Hazardous Substances Directives, RoHS and Waste Electrical and Electronic Equipment, WEEE passed a law to ban the use of 6 harmful substances in consumer products and increase the percentage of recycling used products by the enterprise. It was because used electrical and electronics products had contributed 5% of the solid waste in the whole world. Most of the used products were hazardous to the environment.

Class Activity Two

Conduct an Information search to answer the following questions.

Suggested website for reference:

http://en.wikipedia.org/wiki/Restriction_of_Hazardous_Substances_Directive



1. What are the coverage of RoHS and WEEE on electrical and electronic products?

2. What are the six harmful substances to be banned by RoHS?



Pollutants from Electrical and Electronic products

One abandoned TV set contains 1.8 kg of lead. When it is put into the landfill, the lead will probably be drained into underground water. Taking-in of this lead-polluted water will cause a serious detrimental effect to the human nervous system. The PVC used in the outer layer of conducting wires for all electrical appliances will produce fatal gases when they are burnt in the incinerator. The BFR often used in the printed circuit board also has this fatal effect.

Astonishingly, there are tremendous amount of mercury inside the LCD monitor, if they are abandoned in the landfill, it will cause a disaster to the ecosystem and eventually to the human beings.

The enterprise takes an initiative to launch a stringent recycling scheme for their products not only because of the laws enacted (though it is related to an enterprise survival). It is mainly driven by the consumers' awareness of environmental issues. In the past, most of the enterprises deliberately shorten the product life cycle and launch new models frequently to promote sale and profit. However, it also causes over usage of natural resources and causes tremendous pollution problem by the wasted products. Up to this moment, the recycling of used products by enterprise is only 11%, it is still far away from the environmental point of view.



Alternate or Renewable Energy

Solar energy seems to be the most possible alternate energy to fossil fuel in next 20 years. It is expected that 10% of the energy consumed by the whole world each year will come from solar energy. The popularity is mainly due to the breakthrough in technology. The cost of solar panel will drop to a level that most of the families can afford to buy. The wind power comes next as the speed of wind power that is still not high enough for generating sufficient electricity in most regions. The limitation from mechanical parts seems not to be solved in the near future. The ethanol and organic diesel will be the second choice to substitute the fossil fuel.



Class Activity Three

Conduct an Information search to answer the following questions.

Suggested website for reference:

http://en.wikipedia.org/wiki/Brominated_flame_retardant



1. What is BFR? Why it is used in the printed circuit board?

2. Why the recycling rate is so low? What factors hinder the enterprise to recycle the used products?

Example 1: Energy Saving Lightings - Compact Fluorescent Light (CFL) Bulbs



CFLs can improve the quality of environment and reduce business and home energy bills. Generally speaking, lighting uses roughly 10-20% of the total energy expenditure in



commercial buildings. At homes, lighting consumes 5%-8% of the total energy bill.

Substituting standard incandescent bulbs by CFL bulbs will use approximately 70% energy less for nearly the same amount of light output. Replacing a 100-watt incandescent with a 32-watt compact fluorescent bulb can save at least US\$30 in energy costs over its service lifespan.

CFL bulbs usually last up to 10 times longer than the less efficient light bulbs, thus, maintenance costs are reduced. (Source from U.S. Consumer Product Safety Commission)

Common replacements:

- 9W compact fluorescent light bulb replaces a 40W standard bulb;
- 13W compact fluorescent light bulb replaces a 60W standard bulb;
- 23W or 24W compact fluorescent light bulb replaces a 100W standard bulb.

Do you know what materials/parts are inside the CFL bulbs?



Example 2 : Energy Saving Lightings - Fluorescent Light

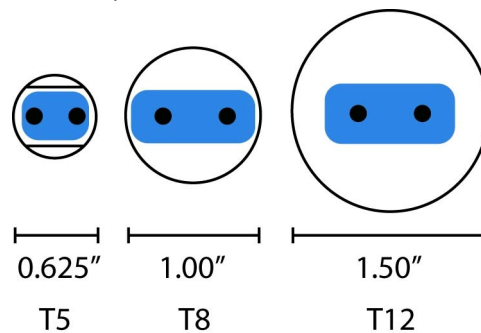


What does T5 mean?

The “T” in lamp nomenclature represents the shape of the lamp-tubular. The number following the “T” usually represents the diameter of the lamp in eighths of an inch (1 inch equals 2.5 centimetres). T5 lamps have a diameter equal to 5 times an eighth of an inch, or 5/8”. These lamps are approximately 40% and 60% smaller than T8 and T12 lamps respectively.



Diagrams of lamp ends of T5, T8, and T12 lamps as below show that pin base type of T5 lamps is different from that of T8 and T12 lamps. T5 lamps have a miniature bi-pin base while T8 and T12 lamps use a medium bi-pin base.



Are T5 lamps really good for the environment?

It has been tested by EMSD that the efficacy of 28W T5 lamps is equivalent to that of T8 and T12 lamps and consumes 36% less energy than those of T8 and T12 lamps, the compact size of T5 lamps can reduce the amount of materials used in their manufacture. The potential toxic substance contamination and packaging materials needed for shipment and sale will become less. Thus, T5 lamps can have less impact on the global environment than T8 lamps.

In addition to their smaller dimensions, T5 lamps have an improved phosphor coating that prevents mercury from being absorbed into the phosphor and the bulb glass. Therefore, this technology allows the reduction of mercury content in the lamp. A T5 lamp contains less than 30 milligrams of mercury.

What is the mercury content in traditional florescent lamp?



Advantages of using T5 florescent lamp

Compared to the larger T8 or T12 lamps, T5 lamps save material. The reduced surface area allows manufacturers to use less glass and phosphor material in manufacturing T5 lamps than those of T12 lamps. Manufacturers claim that a T5 lamp requires 38% less glass than a T8 lamp. In a whole, T5 lamps can reduce packaging materials by up to 50%.



Class Activity Four – Technological Principles of CFLs

Conduct an information search and through class discussion to answer the following questions.

Suggested websites for reference:

http://en.wikipedia.org/wiki/Compact_fluorescent_lamp

http://www.winstar-lighting.com/chinese/t5_advantage_c.htm



1. *Now we all know CFLs can highly reduce the electricity bill but not at the expenses of the amount of light output. Do you know what materials are inside the CFL bulbs? Why most of the CFLs are in the shape of spiral tube?*

2. *As explained above, the T5 has more benefits to the environment than T8 and T12, however, why not so many people are going to replace their fluorescent lamps at home?*



Tasks



- 3 to 4 students in a group
- Conduct extensive information search about the Green design, Green technology and Green enterprise
- Role play: School Manager and Product Designer

Task 1: School Manager

Assuming that you are a manager of the school, you have to propose a sustainable Green policy for the school. The objective of the proposal is to provide school with a number of feasible Green policies to save energy and be environmental friendly. The strategies may include, for examples, the replacement of energy-saving hardware, control of paper use and the use of alternate energy, etc. You can draft the proposal based on your school situation. You need to conduct interviews to collect primary data from the stakeholders in schools, such as principal, teachers, fellow students, parents, clerical and supporting/minor staff. The proposal can be presented with PowerPoint and in papers.

Task 2: Product Designer

Assuming that you are a group of Product Designers, you need to design an Electronic gadget. What Green design and Green policy will you consider in the product development cycle? You need to explain the Green design parameters in the PowerPoint presentation and design a poster to highlight the Green features of your product.





Form and Worksheet

Interview Record Form

For individual/group use

Worksheet Code :	D&T/CS-3G-WS01	Date: ____ / ____ / ____
Group/Name :		Class: ____
Task:	Interview school stakeholders to collect information about the way of promoting sustainable Green policy in school	
<p>Name of Interviewee: _____ -</p> <p>Suggested Interview Questions:</p> <ol style="list-style-type: none">1. <i>Do you think our school is Green enough?</i>2. <i>What measures can be taken to cut down the electricity bill?</i>3. <i>Should we replace all existing lightings by the energy saving lightings?</i>4. <i>Can we reduce the use of paper?</i>5. <i>Can we breakeven the capital cost to be invested in improving the energy efficiency?</i>		
Teacher Remarks:		



Worksheet: Propose a sustainable Green policy

For group use

Worksheet Code :	D&T/CS-3G-WS02	Date : ____ / ____ / ____
Group:		Class : _____
Task:	Propose a sustainable Green policy for a school	
Objectives:		
Existing Situation/Problem: (Hint: Based on the information collected by the focus group interviews to summarize the major area of concern about the Green issue of the school campus)		
Action Plan: (Hint: Prepare a to-do list with major time frame to improve the school sustainability)		
Justifications: (Hint: Provide evidences or forecast the measures to be taken that can improve the school sustainability)		
Resources: (Hints: Considering the existing resources that can be rearranged to implement the plan without additional funding)		
Budget Planning: (Hints: Allocate funding/resources to the plan)		
Schedule: (Hints: Prepare a feasible schedule that can minimize the impact to the school daily operation)		
Manpower/organization: (Hints: Estimate the manpower and man-hour needed to implement the plan)		
Teacher Remarks:		



Worksheet: List Green design features

For individual/group use

Worksheet Code :	D&T/CS-3G-WS03	Date: ____ / ____ / ____
Group/Name :		Class: ____
Task:	List the Green design features to be adopted in your new product.	
Type of Product:		
Green Design Features: (Hints: Design features need to be quantified, such as the percentage of packaging materials to be saved and the percentage of weight to be reduced, and explanation on how these design features can be regarded as 'Green design')		
Teacher Remarks:		

Poster Design Worksheet

For individual use

Worksheet Code :	D&T/CS-3G-WS04	Date: ____ / ____ / ____
Name :		Class: ____
Task:	Design a Promotion Poster for your new product with focus on the Green design features.	
(Hints: A Green message or slogan should be included in your design)		
Teacher Remarks:		



Assessment Rubrics for Final Presentation

The checklist rubric

Assessment Code:	SAS-CHK-01		
Student Name:			Team:
Focus of Assessment:	Teamwork		Date: ____/____/____
Criteria	Self	Peer	Teacher
13. I understand the lesson objectives.	Yes / No	Yes / No	Yes / No
14. I work with team members cooperatively.	Yes / No	Yes / No	Yes / No
15. I give my views responsibly.	Yes / No	Yes / No	Yes / No
16. I respect and listen to other members' ideas.	Yes / No	Yes / No	Yes / No
17. I can draw conclusion after this lesson.	Yes / No	Yes / No	Yes / No
18. I am satisfied with my learning today.	Yes / No	Yes / No	Yes / No

The peer assessment rubric

Assessment Code:		SAS-CHK-02																				
Peer Assessment for Final presentation																						
Team:				Date:										_/_/_								
Assessors:				Class:																		
Focus	No	Scores				Assessment Criteria										Scores						
Knowledge	1	1	2	3	4	5	Understanding of the objective										6	7	8	9	10	N/A
	2	1	2	3	4	5	Have the “know-how”										6	7	8	9	10	N/A
	3	1	2	3	4	5	Clear definition of work										6	7	8	9	10	N/A
	4	1	2	3	4	5	Content is at appropriate level.										6	7	8	9	10	N/A
	5	1	2	3	4	5	Assign appropriate responsibility and person										6	7	8	9	10	N/A
Attitude	6	1	2	3	4	5	Good communication										6	7	8	9	10	N/A
	7	1	2	3	4	5	Fair share of workload										6	7	8	9	10	N/A
	8	1	2	3	4	5	Good time management										6	7	8	9	10	N/A
	9	1	2	3	4	5	Work in synergy										6	7	8	9	10	N/A
	10	1	2	3	4	5	Active participation										6	7	8	9	10	N/A
Presentation	11	1	2	3	4	5	Appropriate strategy										6	7	8	9	10	N/A
	12	1	2	3	4	5	Appropriate organization										6	7	8	9	10	N/A
	13	1	2	3	4	5	Appropriate workload										6	7	8	9	10	N/A
	14	1	2	3	4	5	Show appropriate of IT or equipment										6	7	8	9	10	N/A
	15	1	2	3	4	5	Show quality output										6	7	8	9	10	N/A
Total Scores																						

* Performance descriptors: 1 is incomplete; 5 is fair; 7 is good; 8 is very good; 9 is outstanding effort and 10 is excellent.



References

1. Compact Fluorescent Light Bulbs
<http://www.bellaonline.com/articles/art37906.asp>
2. Proposal writing
<http://www.nsf.gov/pubs/1998/nsf9891/nsf9891.htm#step1>
3. Hong Kong Productivity Council
<http://www.hkpc.org/html/eng/common/index.jsp>

