

Introduction

Plastic is a kind of polymer with a high molecular weight. Because of its characteristics of light weight, high durability, malleability and low production cost, it has been widely applied in our everyday lives. Although it is very convenient to use, it fails to degrade naturally even after hundreds of years and as such causes tremendous problems for landfill sites. Furthermore, the combustion of plastic generates toxic substances. When plastic rubbish gets into the oceans, it can be carried by the ocean currents and ends up forming sea garbage gyres which threaten the marine ecosystem to a large extent.

This exhibition combines elements of science and art. A large centrepiece comprising plastic flotsam collected from the beach cleaning operations in the North Sea, Hawaii, the Baltic Sea and the rest of the world is displayed with the aim of arousing public awareness of plastic waste. In addition, the exhibition also makes use of different video footage and interactive exhibits featuring unique designs. Through the exhibition, visitors can gain an in-depth understanding of the chemical composition, classification and recycling processes of different plastic materials, and also learn about the harmful effects of plastic waste on birds and marine animals. The aim is to let us realise that we must curtail our consumption of plastic and encourage the recycling of plastic immediately.

To enrich the educational experience of the exhibition, we have specially invited the students of the “Project WeCan” to make different works of art using plastic garbage for display in the exhibition.

Jointly presented by the Leisure and Cultural Services Department and Consulate General of Switzerland
Jointly organised by Hong Kong Science Museum, Museum für Gestaltung Zurich, and Connecting Spaces
Hong Kong – Zurich, Zurich University of the Arts
An exhibition by the Museum für Gestaltung Zurich
Sponsored by Drosos Foundation
Partners: Project WeCan and UOB Art Academy
Supporting Organisations: Hong Kong Youth Arts Foundation, Ocean Recovery Alliance and
Inter-departmental Working Group on Clean Shorelines

Curriculum Links

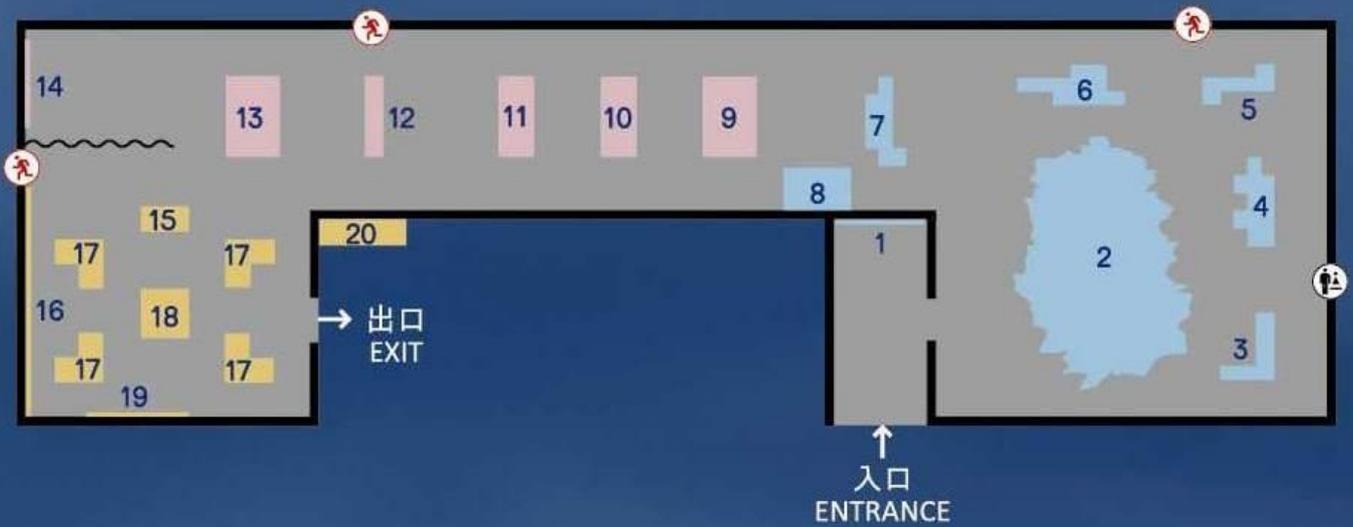
Primary School General Studies: “People and Environment” & “Science and Technology in Everyday Life”
S1-S3 Science: “Materials of the Modern World”
S4-S6 Chemistry Compulsory Part: “Fossil Fuels and Carbon Compounds” & “Chemistry of Carbon Compounds”
S4-S6 Chemistry Elective Part: “Materials Chemistry”
S4-S6 Combined Science Chemistry Part: “Fossil Fuels and Carbon Compounds”
S4-S6 Liberal Studies: “Energy Technology and the Environment”

Information on Visits

Exhibition Period: 27.11.2015 – 17.2.2016

Venue: Special Exhibition Hall, Hong Kong Science Museum

Floor Plan



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|---|-----------|-----------------------------|
| | 充斥海洋的塑膠 | Plastic in the Sea |
| 1 | 塑膠的洗禮 | Immersion |
| 2 | 海洋的惡夢 | A Nightmare at Sea |
| 3 | 塑膠垃圾漩渦 | Plastic Garbage Gyre |
| 4 | 未來考古學 | Archaeology of the Future |
| 5 | 充斥海洋的塑膠垃圾 | Plastic Garbage in the Sea |
| 6 | 塑膠對動物的影響 | Effects on the Animal World |
| 7 | 微膠粒 | Microplastic |
| 8 | 美人魚的眼淚 | The Mermaid's Tears |

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|----|---------|------------------------------|
| | 日常的塑膠用品 | Plastic in Everyday Life |
| 9 | 塑膠的材料科學 | Material Science of Plastics |
| 10 | 即用即棄的塑膠 | Plastic: Fast Consumption |
| 11 | 添加劑 | Additives |
| 12 | 微塑膠顆粒 | Microplastic Particles |
| 13 | 材料的循環 | Material Cycles |
| 14 | 塑膠海洋劇場 | Plastic Ocean Theatre |

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|----|---------------|---|
| | 香港的海洋塑膠垃圾 | Plastic Sea Garbage in Hong Kong |
| 15 | 塑料的分類 | Classification of Plastic |
| 16 | 保護海岸·廢物不留 | Protect Our Coast · Leave No Trace |
| 17 | 從塑膠垃圾到藝術作品 | From Plastic Waste to Artwork |
| 18 | 香港海灘的塑膠垃圾 | Plastic Waste on Beach of Hong Kong |
| 19 | 清潔海灘及環境藝術攝影計劃 | Beach Clean and Environmental Art Photo Project |
| 20 | 海洋留言板 | Ocean Message Board |

Exhibit Highlights

Plastic in the Sea

The exhibits in this area depict the catastrophe of the sea incurred by plastic garbage. It explores the facts that plastic waste threatens the lives of birds and marine animals, and affects the whole ecosystem.

A Nightmare of the Sea

It is formed by the plastic flotsam collected from the beach cleaning operations in the North Sea, Hawaii, the Baltic Sea and the rest of the world. The severity of sea plastic garbage issue is revealed through this pile of waste.



The Ugly Journey of Our Trash

Marine debris is the rubbish of our everyday lives that makes its way into our ocean. Rubbish travels over land, down streams, rivers and storm drains to the ocean. Once in the ocean, it can drift thousands of miles from its origin to the most remote ocean places, leaving a wake of destruction in its path. Every year, debris kills thousands of marine animals and sea birds, chokes coral reefs and smothers critical environments. It also contaminates our beaches and favorite recreation sites. Better information about sources and impacts is extremely important to drive changes in infrastructure and waste management policies at all levels. Who is responsible? All of us. Together we can help prevent and clear up this mess for a clean, healthy ocean planet.

Effects on the Animal World

Eating

Many animals mistake pieces of plastic for food. Birds eat PET bottle-tops and fire-lighters, as well as various plastic fragments. A remarkable number of remnants of plastic bags were found in the stomachs of dead turtles. Depending on the form of the animals' gullets and stomachs and the way they function, the indigestible pieces cannot be excreted, leading to the animals starving with full stomachs, choking, or suffering internal injuries (perforation or laceration of the intestinal walls.)

Plankton-eating organisms ingest microplastic along with their natural food. Studies of water samples taken from the North Pacific have shown that in the upper seawater column there is, at places, 46 times as much plastic as plankton.

Entanglements

Fishing nets and lines can become deadly traps for marine creatures. Fish, sea mammals and turtles become entangled in the “ghost nets” and suffocate or starve. For shipping, too, these nets, which often form gigantic clumps, represent a serious hazard.

Six-pack rings and other loop-shaped plastic products can spell disaster for playful maritime animals that, once caught up in them, are unable to extricate themselves. When a young animal becomes caught in a plastic product, the injuries caused are particularly serious, as the plastic does not grow along with the animal.



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Microplastic

The effect of ingesting plastic along with food on the various levels of the food chain is currently unforeseeable. As plastics may contain dangerous additives, and certain pollutants can concentrate on plastic, it is thought that the consequences could be far-reaching. Research work on mussels has already shown that microplastic parts can also be absorbed by the tissue of filter organisms.

A dangerous group of substances that concentrate on plastic are POPs – persistent organic pollutants. POPs are produced through chemical processes and are degradable only with great difficulty. As they are almost insoluble in water but easily soluble in fats, they are deposited in the fatty tissue of living organisms. With every further level in the food chain their concentration increases exponentially (bio-accumulation). A number of these substances are suspected of having undesirable effects on the hormone systems of living creatures, or of being carcinogenic. There is good reason to believe that they can have a negative impact on fertility, cause behavioural disorders and lead to defects in the immune system.

Plastic in Everyday Life

Basing on the principle of materials science, these exhibits introduce the chemical composition, classification and recycling processes of different plastic products, and explore the way to minimise the disposal of plastic items.

Material Science of Plastics

Plastics consist of long molecular chains, known as polymers, created by linking the same repeated building element (monomer). Synthetically produced plastics are made from mineral oil, coal or natural gas. A total of 4% of the worldwide production of oil and gas is used in the manufacture of plastics. In addition to synthetic plastics there are also the semi-synthetics which are made from natural polymers such as cellulose. Today organic plastics made from sustainable raw materials are being produced in increasing amounts.

The followings are some common plastic materials:

Polyethylene (PE): PE is produced by the polymerisation of the gaseous substance ethane. It is a rather soft plastic that displays a high level of stability towards chemicals.

- Polypropylene (PP):** PP is a thermoplastic derived from the gas propene. It is the mass plastic with the lowest density. Its stability and resistance to chemicals is similar to that of LD-PE. As it is odourless and does not cause skin irritation, it is widely used in the food and pharmaceuticals industries.
- Polyvinyl chloride (PVC):** PVC is produced from the gas chloroethene, known as vinyl chloride. By adding plasticisers this originally hard, stiff plastic becomes elastic. However, PVC is far from harmless: from the carcinogenic base material to the phthalates that are injurious to health, and poisonous dioxins that are released when it burns.
- Polystyrene (PS):** PS is produced from the colourless liquid styrene. In a foamed state this plastic is known under the trade name Styrofoam. PS has a glass-like, shiny surface. It is hard and brittle. In a foamed state the material is used as thermal insulation. PS is problematic on account of carcinogenic materials in the production and processing. In addition it also is difficult to recycle.
- Polyethylene terephthalate (PET):** PET is produced from terephthalic acid and ethylene glycol. In its amorphous state, it is a transparent, lightweight, impact-resistant material that is used to make bottles for soft drinks and water. PET is also processed to form textile fibres. It retains its shape, is crease and tear-resistant, and repels water. PET bottles releasing acetaldehyde and antimony into the liquid they contain is problematic. However the values measured are not regarded as hazardous to health.
- Polyurethane (PU):** PU is the product of the polyaddition of isocyanates (ester) and diols (divalent alcohols). PU is frequently produced as a foamed material. The soft foam that retains its shape is suitable for upholstered furniture, whereas the hard foam is used on the building site. This plastic can also be processed to make paints, adhesives or elastic textile fibres. However, it is difficult to recycle and if burned releases poisonous substances (isocyanate, prussic acid).
- Polycarbonate (PC):** PC belongs to the groups of polyesters and is generally produced from phosgene and bisphenol A. PC is colourless and translucent. It has little resistance to chemicals, but on the other hand is highly resistant to knocks and does not splinter. Therefore PC is ideal for use in the area of optics and for safety glazing. However, as it contains the substance bisphenol A, this plastic is questionable in health terms.

Material Cycles

Plastics are produced from mineral oil and, despite their low price, are a valuable product. Essentially, almost all plastics are recyclable. The best recycling solutions available are those for materials of a single sort, where different kinds of plastic are mixed the processes are more complex. There are various methods available for recycling plastics, for instance, feedstock recycling, mechanical recycling, downcycling and upcycling.

Plastic Ocean Theatre

Constituted by a series of video footage, it elaborates the damage of the sea derived from plastic garbage at different perspectives.

Plastic Sea Garbage in Hong Kong

This corner displays plastic garbage collected and classified from the local beach by students through the beach cleanups organised by the “Project *WeCan*”. Meanwhile, it also showcases different works of art created by students using plastic garbage. In addition, there are panels prepared by the Inter-departmental Working Group on Clean Shorelines to give interpretation on the issue of plastic sea garbage in Hong Kong.

From Plastic Waste to Artwork

Plastic waste can be upcycled to make awesome artwork. Groups of secondary school students took part in two educational programmes, namely Creativity Workshops and the Beach Clean and Environmental Art Photo Project. As part of these projects they used their creativity to inspire people to adopt a new perspective on how plastic waste can be reused and also to enhance awareness of the alarming trend of using too many plastic materials.



Plastic Waste on Beach of Hong Kong

Over 160 students from nine secondary schools participated in Waste Collection Field Trips at Lung Kwu Tan, Tuen Mun in October 2015. The students then utilised appropriate tools to pick up the refuse on the beach. The plastic waste collected from the beach was brought back to the Science Museum for classification. Students learnt how to identify and categorise the seven main types of plastic according to a standard coding system.



Related Links

1. Latest development on Clean Shorelines
<http://hk.science.museum/ms/download/cs.pdf>
2. PowerPoint of briefing session of the "Beach Clean-up" project
<http://hk.science.museum/ms/download/bss.pdf>

Pre-visit Preparation

Kindergartens: Show students some plastic products which are commonly seen in our daily lives. Then, ask them to identify commodities made from plastic in the classroom.

Primary Schools: Guide students to discuss the pros and cons of the use of plastic.

Secondary Schools: Encourage students to research into the seven major types of plastic (such as uses, properties, and composition) according to the standard coding system. Guide students to discuss about how plastic garbage affects the ecological environment.

Post-visit Extension Activities

Kindergartens: Guide students to list out what they can do to reduce the use of plastic, and the correct ways to handle and recycle plastic garbage.

Primary Schools: Encourage students to give thoughts to reusing solid waste and making some handicrafts with plastic garbage.

Examples of handicrafts:

- (1) Cut a plastic bottle in half, and use the lower part for planting.
- (2) Cut out the bottom of an old shampoo bottle, and then add a snap button on it to make a change purse.
- (3) Draw patterns on a bottle cap and then stick a brooch pin/ magnet at the back of the cap to create a beautiful brooch /refrigerator magnet.

Secondary Schools: Instruct students to make biodegradable plastic by using milk and vinegar, so as to deepen students' understanding of biodegradable plastic. After the activity, teacher can guide students to discuss the possible solutions to the problem of plastic garbage.

Making of biodegradable plastic:

Ingredients:

- Skimmed milk 500ml
- Vinegar 60ml
- Beaker
- Spoon
- Filter paper/Strainer
- Kitchen towels

Procedures:

- (1) Heat the milk to lukewarm (or microwave the milk for about 1 minute).
- (2) Pour the milk into the beaker and immediately add vinegar, stirring constantly.
- (3) When the solution separates into curds, discard the liquid from the mixture with filter paper/strainer.
- (4) Use kitchen towels to dry the curds.
- (5) Mould the curds when it is still warm, and then wait until it dries.

Online Resources

1. <http://www.oceanconservancy.org/our-work/international-coastal-cleanup/>
2. http://www.epd.gov.hk/epd/clean_shorelines/tc/
3. http://www.epd.gov.hk/epd/tc_chi/environmentinhk/waste/waste_maincontent.html
4. <http://www.gov.hk/tc/residents/environment/public/activities/envcentres.htm>
5. <http://www.greensense.org.hk/plasticbag/index.php>
6. http://prrc.yot.org.hk/?page_id=86
7. http://prrc.yot.org.hk/?page_id=94
8. <https://www.wastereduction.gov.hk/tc/index.htm>