GREEN SINKS DAY

Delta

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The Chemistry of New Materials: Biocompatibility & Biodegradability

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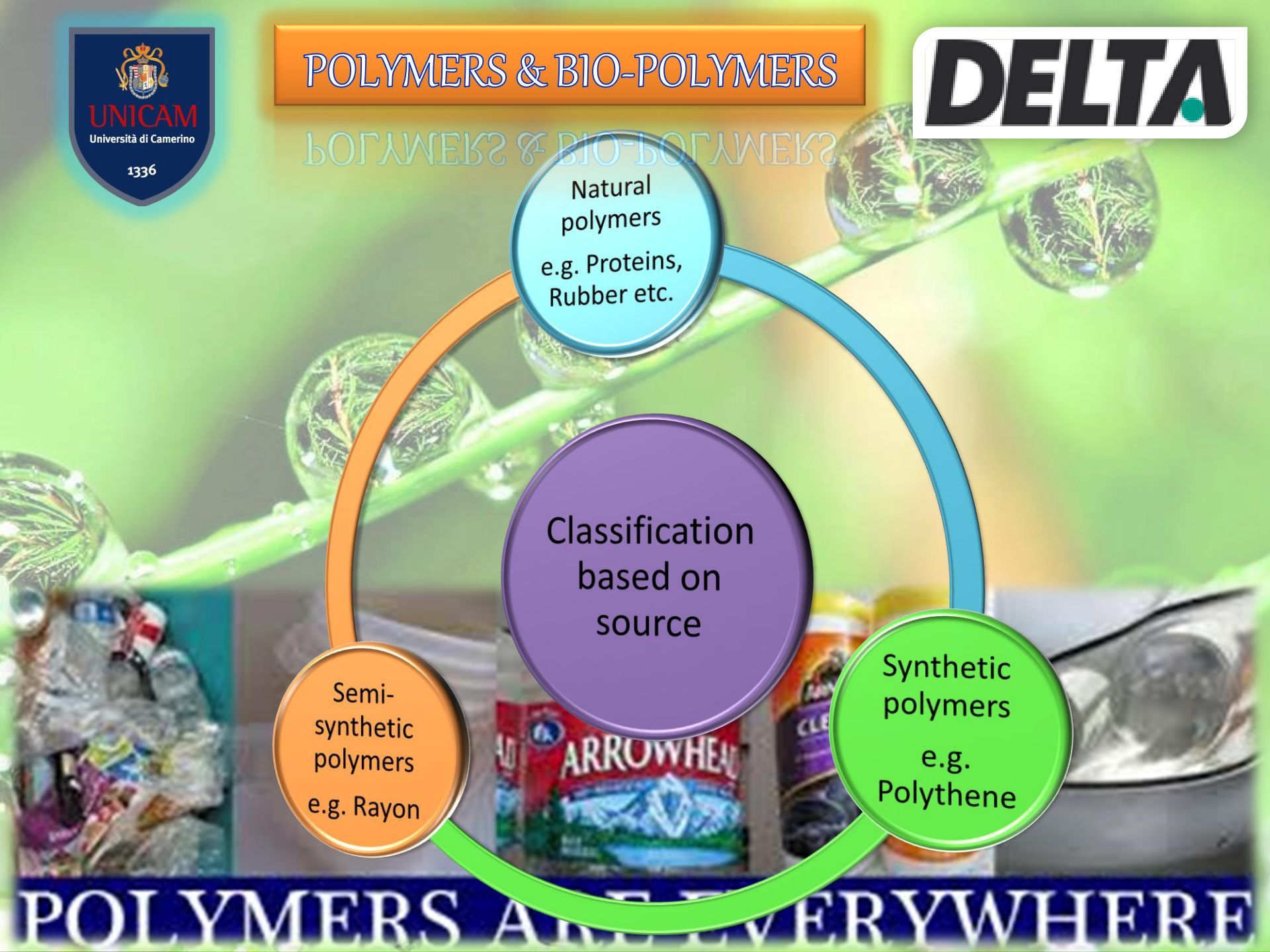
POLYMERS & BIO-POLYMERS



GENERAL COMPOSITES

Polymers:

PE, PP

PVC

POLYSTYRENE

PMMA

PET

AMINO-FORMALDEHYDE

POLYAMIDES

Additives:

Antioxidants

Antistatic

Colors

Impact modifiers

Lubricants

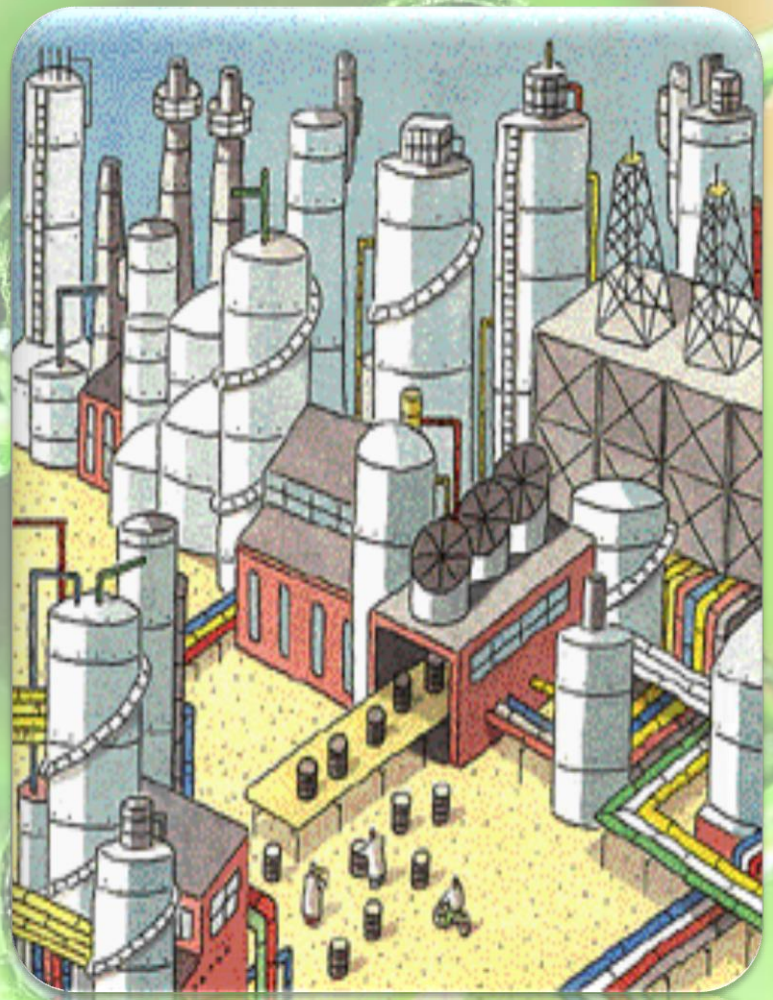
Plasticizers

Stabilizers

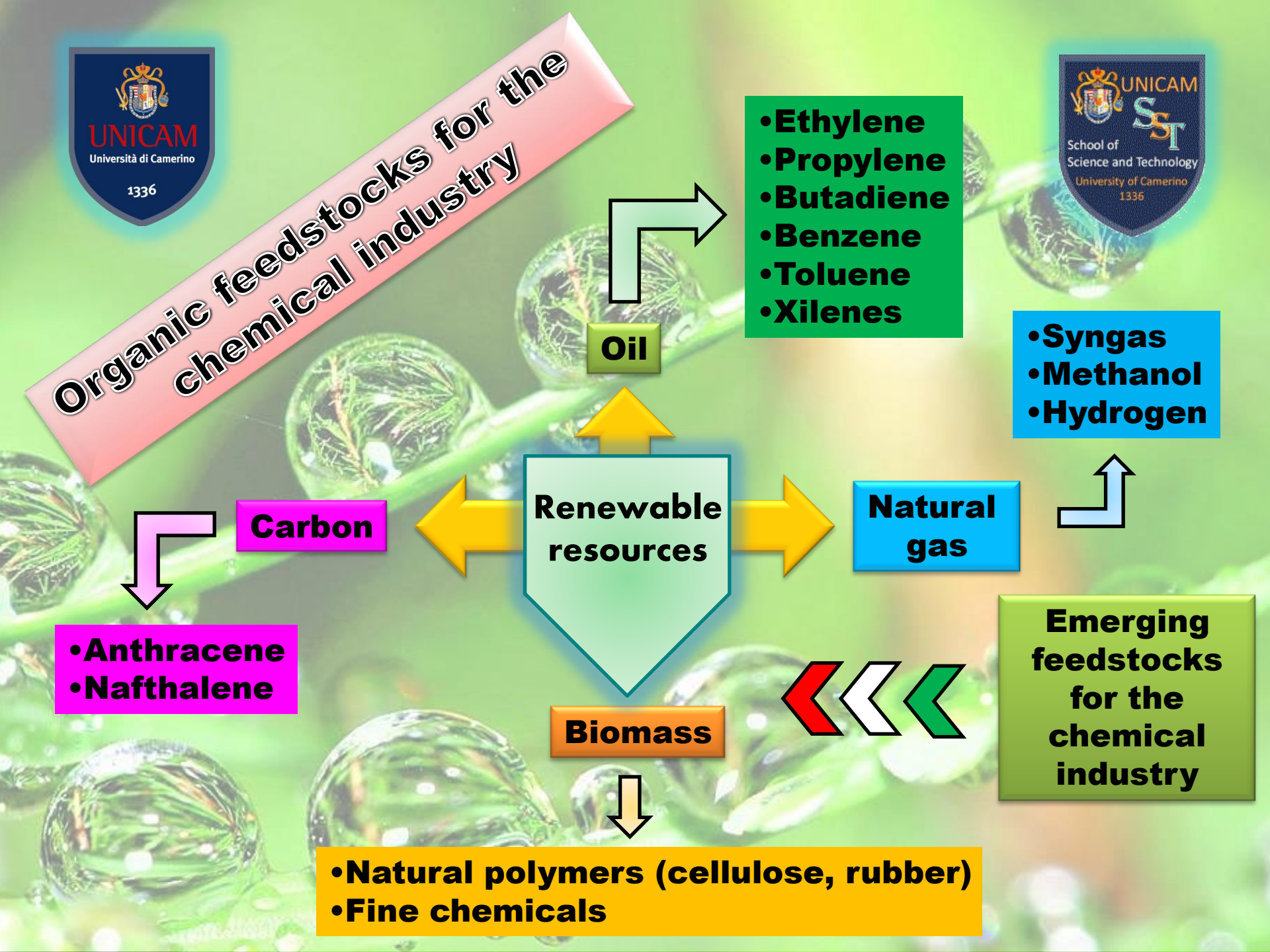
Present situation, organic industrial production from:

PETROLEUM REFINERY

Petroleum feedstock



- Fuels
- Solvent
- Bulk chemicals
- Plastics
- Fibres
- Fine chemicals
- Oils


Organic feedstocks for the chemical industry
Oil
•Ethylene
•Propylene
•Butadiene
•Benzene
•Toluene
•Xilenes
•Syngas
•Methanol
•Hydrogen
Renewable resources
Carbon
Natural gas
•Anthracene
•Nafthalene
Biomass
Emerging feedstocks for the chemical industry
•Natural polymers (cellulose, rubber)
•Fine chemicals

SUSTAINABILITY

"MEETING THE NEEDS OF THE PRESENT WITHOUT COMPROMISING THE ABILITY OF FUTURE GENERATIONS TO MEET THEIR NEEDS."

IS THE GOAL

CHEMISTRY IS GOING GREEN

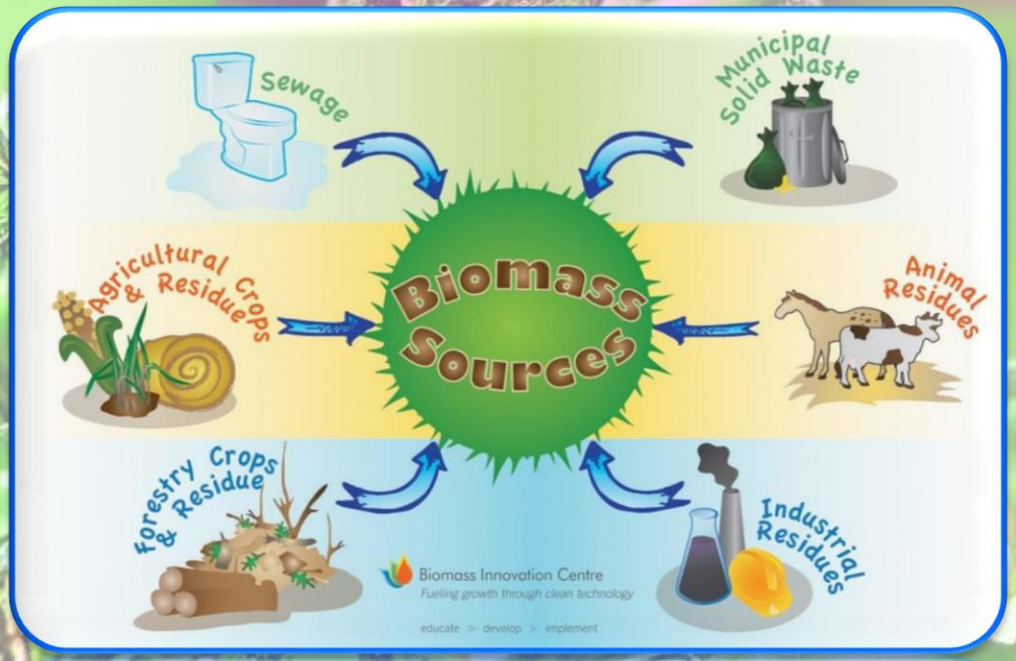
GREEN CHEMISTRY

TECHNOLOGIES THAT ARE ENERGY EFFICIENT, MINIMISE OR PREFERABLY ELIMINATE THE FORMATION OF WASTE, AVOID THE USE OF TOXIC AND/OR HAZARDOUS SOLVENTS AND REAGENTS AND, WHERE POSSIBLE, UTILISE RENEWABLE, RAW, MATERIALS.

IS THE MEAN

THE CHALLENGE

Organic industrial production from renewable resources (BIOMASS)



"The term BIOMASS means any organic matter that is available on a renewable basis."

Energy crops and trees, agricultural food and feed crop residues, aquatic plants, wood and wood residues, animal wastes, and other waste materials."

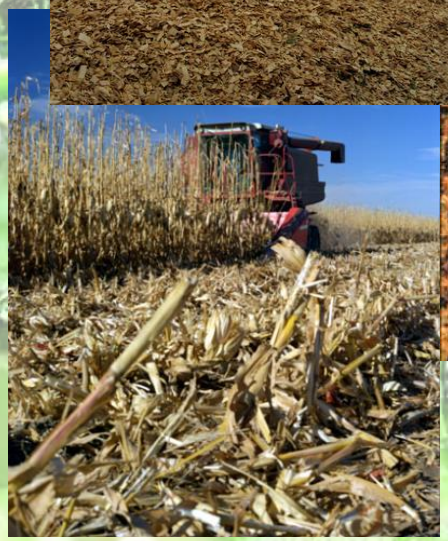
The Unique Role of Biomass

While the growing need for sustainable electric power can be met by other renewables…







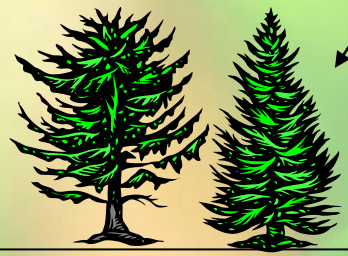



Biomass is our only renewable source of carbon-based fuels and chemicals

... TIME LINE ...

SUNLIGHT ENERGY

CO_2



1-10 years

Oil refinery

Consumer

Biomass Carbohydrate

Crude oil
Natural gas
Coal

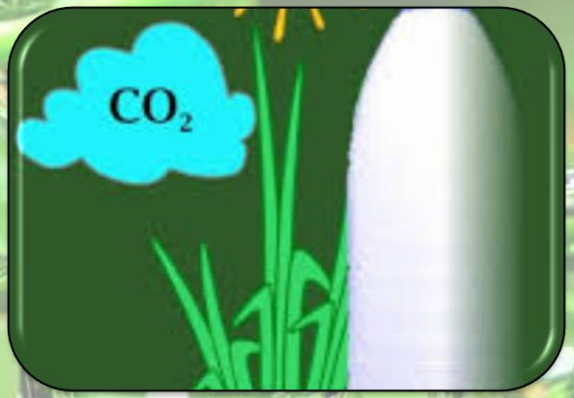
Bio refinery

> 10^6 years

BIOCOMPATIBILITY

PETROLEUM BASED POLYMERS

COMPOSITE MATERIALS



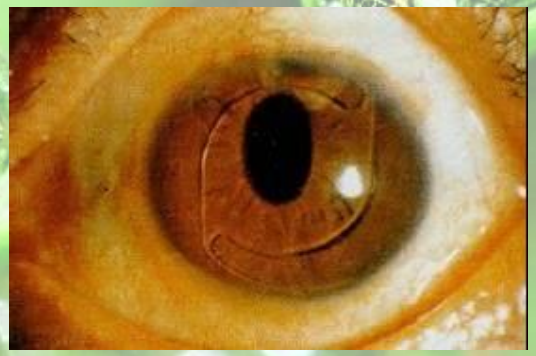
BIO BASED POLYMERS

BIODEGRADABILITY

... Interconnection...

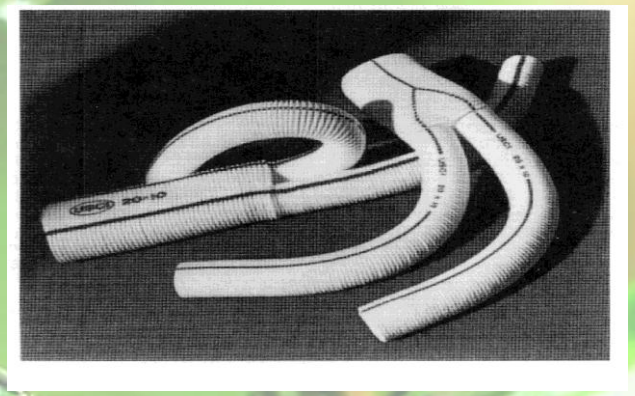
What Does BIOCOMPATIBLE Mean?

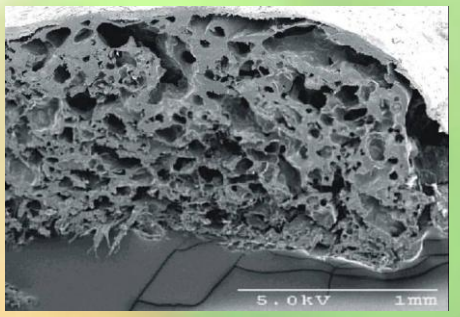
Biomaterial is "A material intended to interface with biological systems to evaluate, treat, augment or replace any tissue, organ or function of the body"



Contact Lens

Image of vascular grafts constructed of expanded Teflon





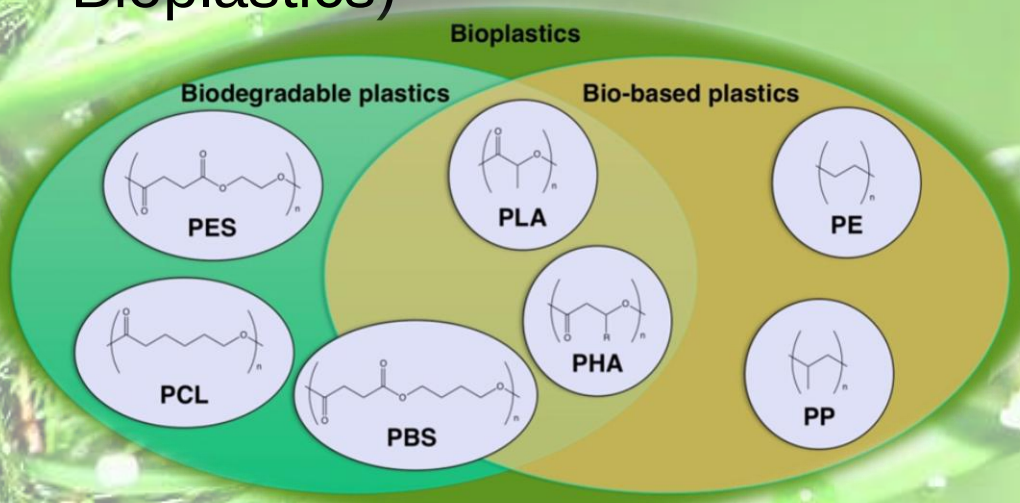
Composite foam seeded with bone marrow stromal cells

BIOCOMPATIBILITY – The ability of a material to perform with an appropriate host response in a specific application

HOST RESPONSE – The response of the host organism (local & systemic) to the implanted material devices

...BIO BASED & BIODEGRADABLE ... EMERGING TRENDS

The term "bioplastics" refers to a biodegradable plastics and/or plastics derived from renewable resources (the definition from European Bioplastics)



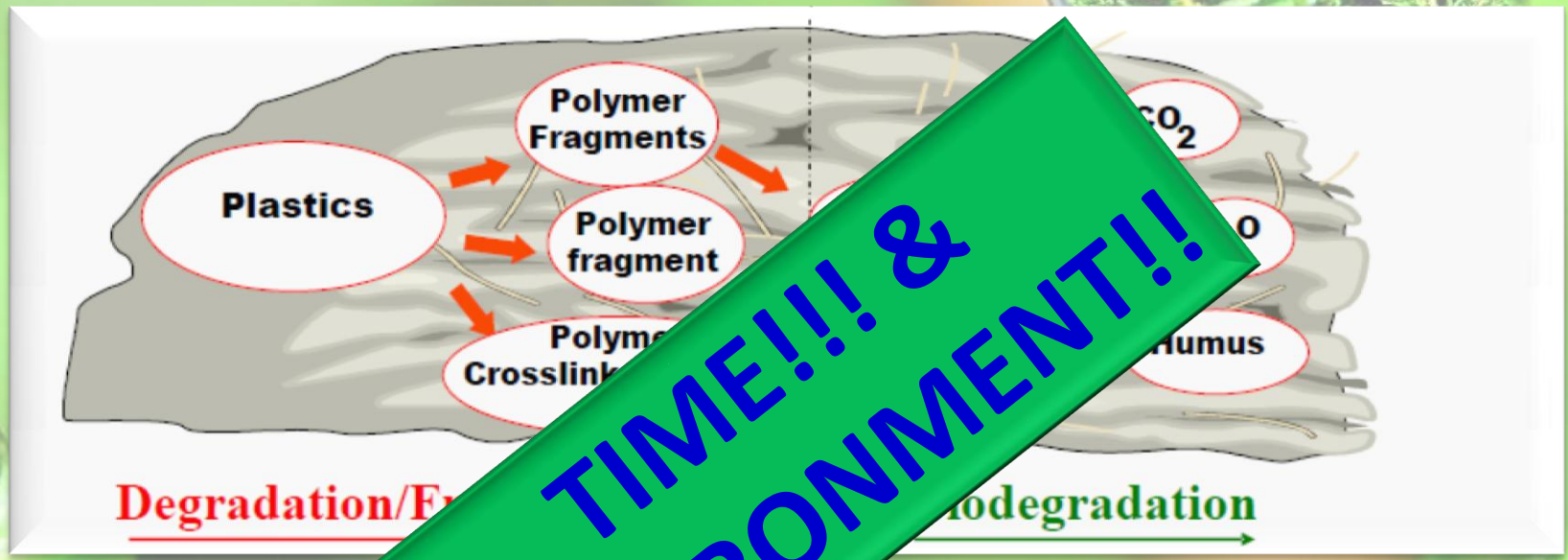
Renewable Resource-based

Microbial synthesized

- **PLA Polymer (From Corn)**
- **Cellulosic plastics**
- **Soy-based plastics**
- **Starch plastics**

- **Polyhydroxy alkanoates (PHAs)**
- **Polyhydoxybutyrate co-valerate (PHBV)**

What Does BIODERGRADABLE Mean?



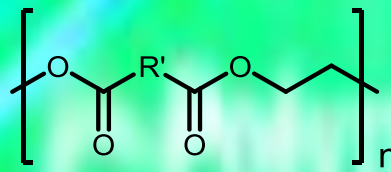
TIME!!! & ENVIRONMENT!!

BIODEGRADABI **plete assimilation of the degradated products as a food so the soil microorganisms would ensure returning the carbon int he ecosystem safely and effectively**

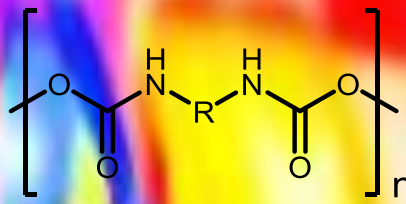
APPLICABLE TO SINGLE-USE, SHORT LIFE DISPOSABLE PACKAGING & CONSUMER GOODS

Compounds VS Sustainable alternatives

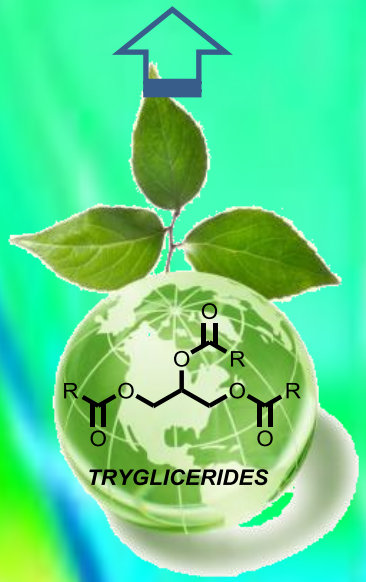
RENEWABLE RESOURCES



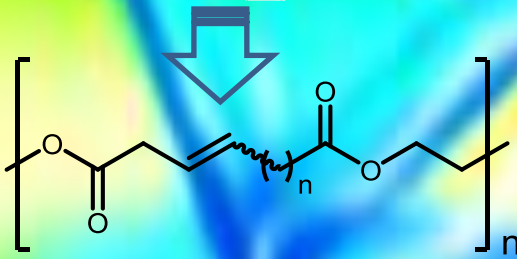
Saturated Polyester Resins



Polyurethane Sistems



HIGH SUSTAINABILITY



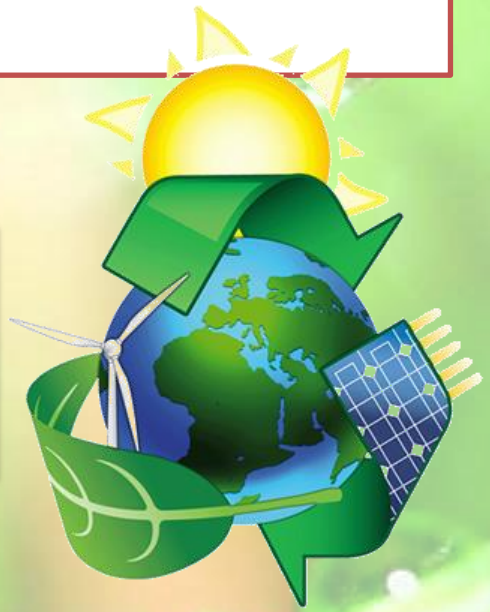
Unsaturated Polyester Resins

H_2O based PAINTS

Determination of BIOGENIC FRACTION (^{14}C)

The method of ^{14}C (Carbon-14) or radiocarbon, is a radiometric dating method, based on the measurement of the relative abundances of carbon isotopes.

Determination of
BIOGENIC FRACTION
«pMC» (percent modern carbon)



FOSSIL RESOURCES
% ^{14}C = 0

RENEWABLE RESOURCES
% ^{14}C = X

pMC will be due to the organic fraction coming from **RENEWABLE SOURCES**

The method of ^{14}C allows the dating of organic origin materials (bones, wood, textile fibers, seeds, wood charcoal, etc …

...Why BIO-BASED Plastics ?...

Comparing the properties of bio-based polymeric materials with the conventional synthetic petroleum derived polymers shows a major potential of these polymers for the production of well-performing bulk packages.

Petrochemical-based sources are a limited solution.

The increase of oil prices.

Natural resources are inexpensive and readily available.

Reduction in CO_2 emissions.

Renewable biological origin, easier availability

… Acknowledgment …

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