

Chem 471 Midterm

- Today global production of **anthropogenic substances** is more than **500 million tons/year**.
- There are more than **100.000 synthetic chemicals** used in everyday products.
- Global annual production of **petroleum based liquid fuel oil** is about **3 billion tonnes**.
- There are more than **300 man-made chemicals** found in the blood stream of all people tested around the world.
- Global Distillation: Persistent organic pollutants (**POPs**), are transported from warmer to colder regions of the Earth (Poles and mountain tops).
- **Natural Elemental Cycles:** The path atoms take from the living (biotic) to the non-living (abiotic) world and back again is called a 'biogeochemical cycle'. Examples: **Carbon cycle (below)**

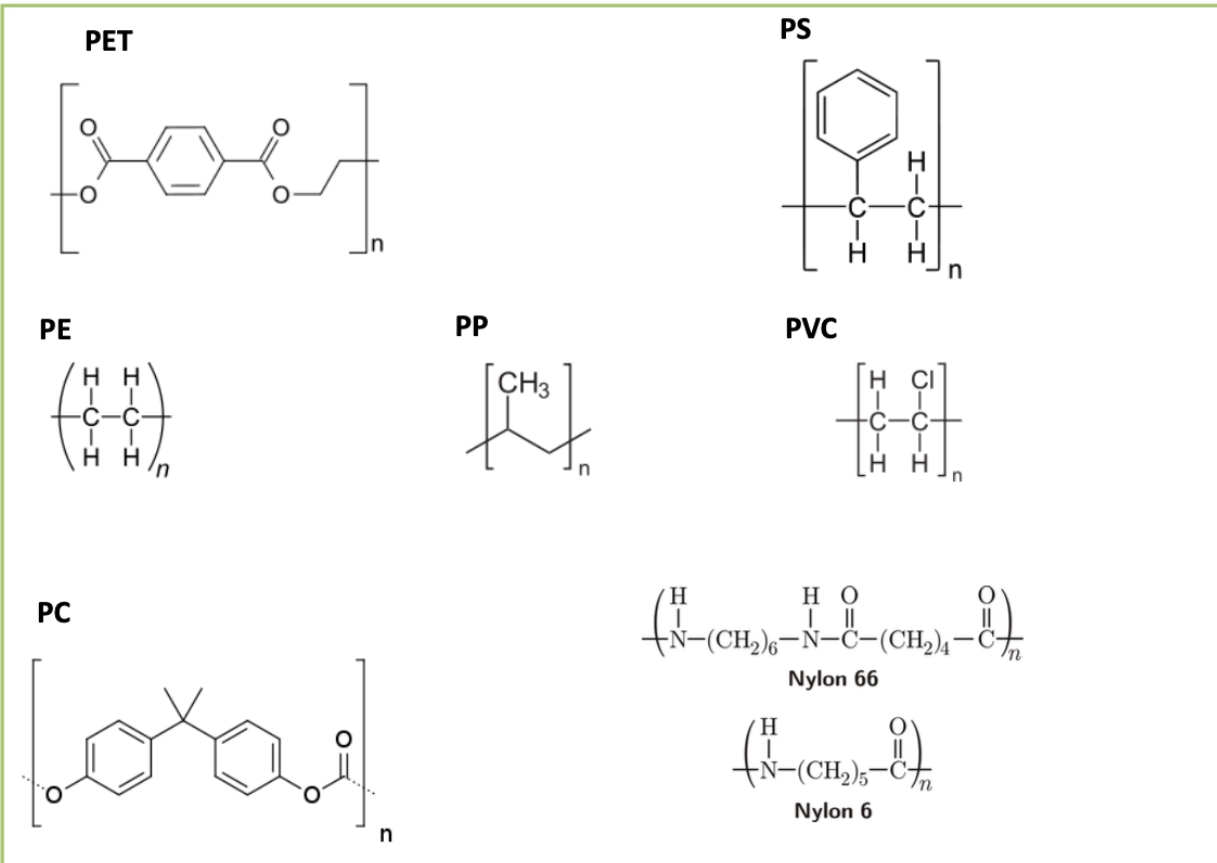
Some drawbacks of **fertilizers (!!!)**

- 1) Promote growth of harmful insects
- 2) Keep plant roots short, weakening the plant
- 3) Causes nitrate accumulation in plants, later causing the formation of nitrosamines when eaten with meat

- According to latest '**Planetary Boundaries**' studies, **N and P elemental** cycles were disrupted by human activity to a dangerous level, negatively affecting the future of life...
- The biogeochemical cycles of nitrogen and phosphorus have been **radically changed by humans** as a result of

many industrial and agricultural processes. **Fertilizer** production and application is the main concern.

- While global annual **plastic consumption** was 5 million tonnes in 1950, today it reaches to more than **300 million tonnes**.



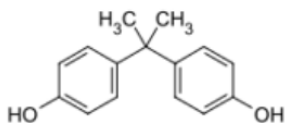
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- As plastic decompose over decades it slowly releases harmful additives and decomposition products to the environment.

- Microplastic Pollution: In 2014 total global amount of microplastic pollution was estimated to be in the range of 90000-240000 tonnes.

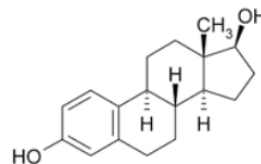
BPA

BPA is an **endocrine disruptor** at low very doses, found in blood stream of the majority of population (95% in USA in 1995), demonstrated to induce growth of prostate cancer cells in test animals. Prenatal exposure in humans is strongly suspected to cause life long effects such as **obesity, brain development and memory problems, hyperactivity, thyroid disorders, alteration in breast development, increase in breast and prostate cancer risk, decrease in female fertility.**



BPA

17β-Estradiol



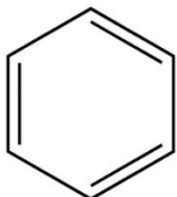
Endocrine Disrupting Chemicals (EDCs):

- **Endocrine disruptors** are chemicals that, at certain doses, can interfere with the endocrine (or hormone system) in mammals.
- deformations of the body (including limbs); obesity; immune disorders; breast cancer, prostate cancer,

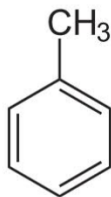
- Toxic metal pollutants (most are considered as heavy metals) are **persistent**, generally **bioaccumulate** and **biomagnify**, some have strong **EDC** properties.
- Aluminum: 58.8 million tons

Organic Anthropogenic Chemicals

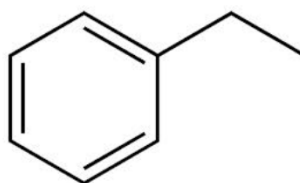
❖ BTEX Compounds



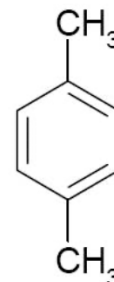
benzene



toluene



ethyl benzene



xylene

(tiner=thinner)

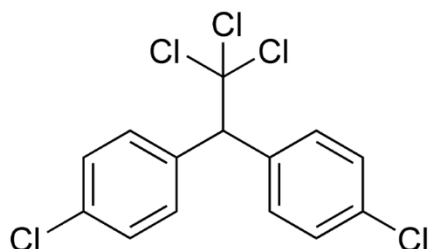
Carcinogenicity ↓-----→

- petroleum products (top 20 in production volume in US)
- used in chemical manufacturing (solvent, additive etc.)

Pesticides

❖ DDT (organochlorine):

dichlorodiphenyltrichloroethane



“persistent, bioaccumulative and biomagnifies”

- ❖ From 1950-1970, it was extensively used worldwide in agriculture, approximately 400.000 tonnes/year

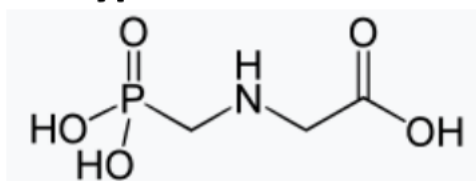
- ❖ It is banned in 1972 in USA followed by Europe. Included in Stockholm Convention (2004) that restricts the use of some harmful POPs.

❖ Rachel Carson's book:

«**Silent Spring**» lead to public reaction and banning (!)

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Glyphosate herbicide



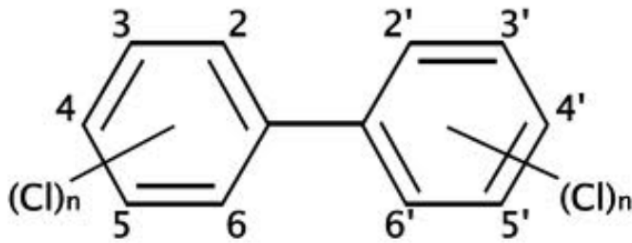
Latest most widely used herbicide, may cause types cancers, and **Colony Collapse Disorder (Bees Colonies) !!!**

PCBs – Polychlorinated biphenyls

❖ PCBs (130 congeners)

polychlorinated biphenyls

(prepared by electrophilic chlorination)



O

viscous liquid

'persistent, bioaccumulative (half-life near 10-15 years, biomagnifying'

❖ widely use in;

- lubricants
- hydraulic liquids
- dielectric fluids
- transformers
- capacitors
- coolants
- plasticizers
- paints
- stabilizers in PVC
- flame retardants
- adhesives
- cosmetics