

CHEMISTRY: THE CENTRAL SCIENCE

General Chemistry I, Lecture Series 1

Pengxin Liu



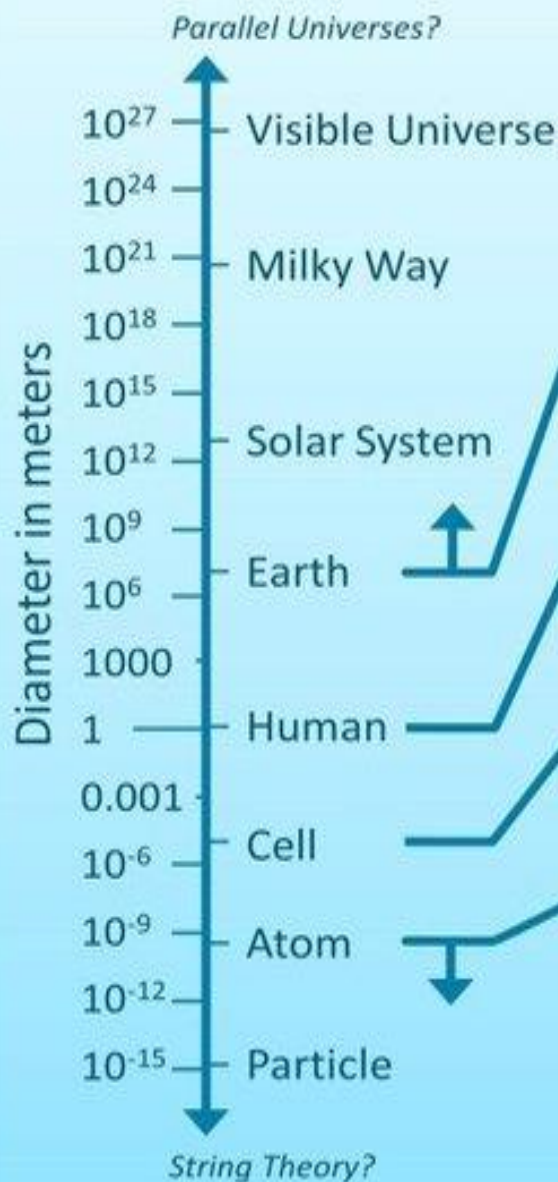
Outline

- What is Chemistry
- What has chemistry achieved and what hasn't ?
- What do we benefit from learning chemistry ?

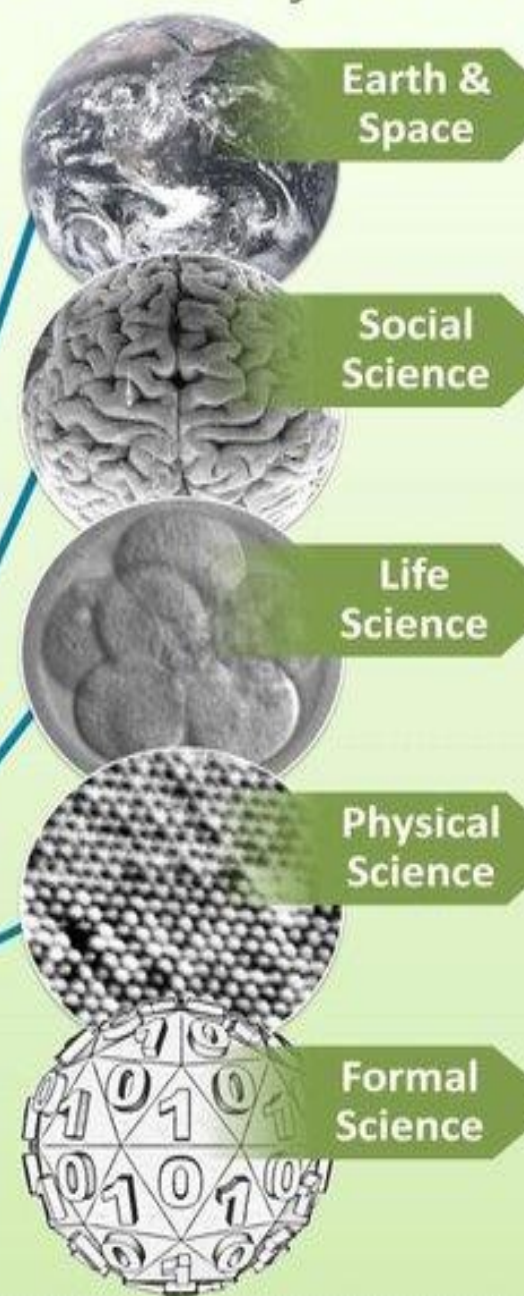
What is Chemistry

- 化学是自然科学的一种，主要在分子、原子层面，研究物质的组成、性质、结构与变化规律，创造新物质。(via. 百度百科)
- Chemistry is the scientific study of the **properties** and **behavior** of **matter**. It is a natural science that covers the elements that make up matter to the compounds composed of atoms, molecules and ions: their composition, structure, properties, behavior and the changes they undergo during a reaction with other substances. (via. Wikipedia)

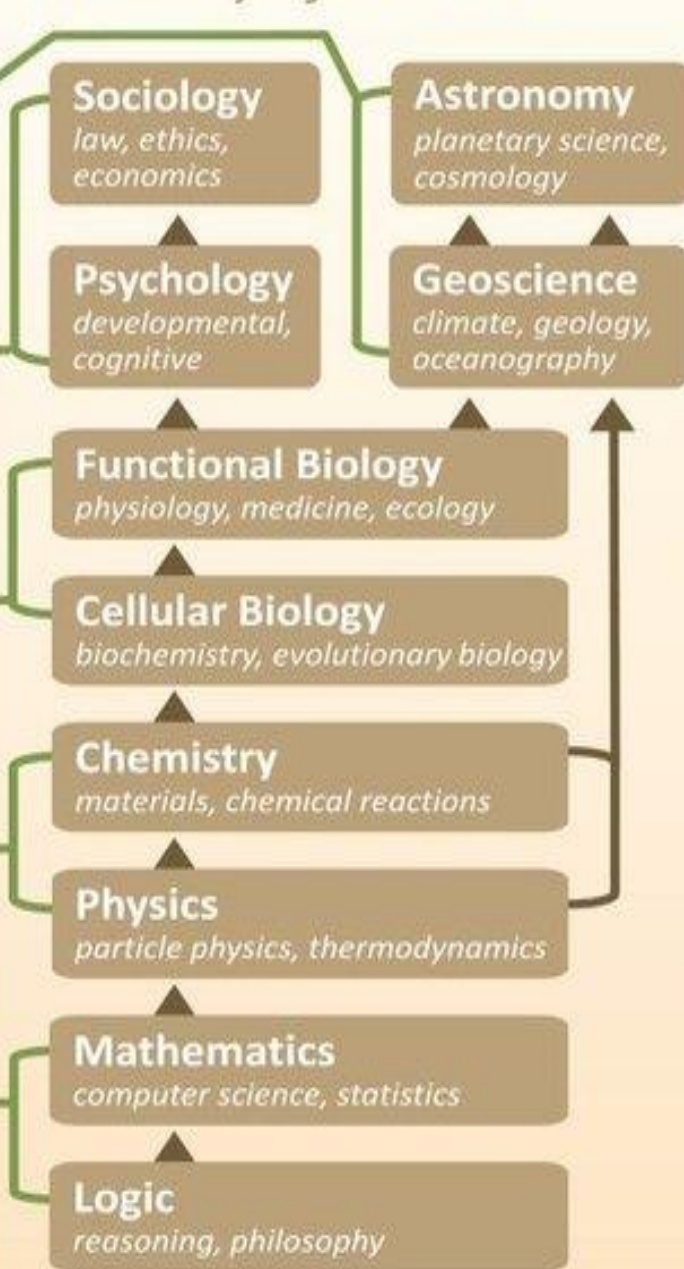
Scale of the Universe



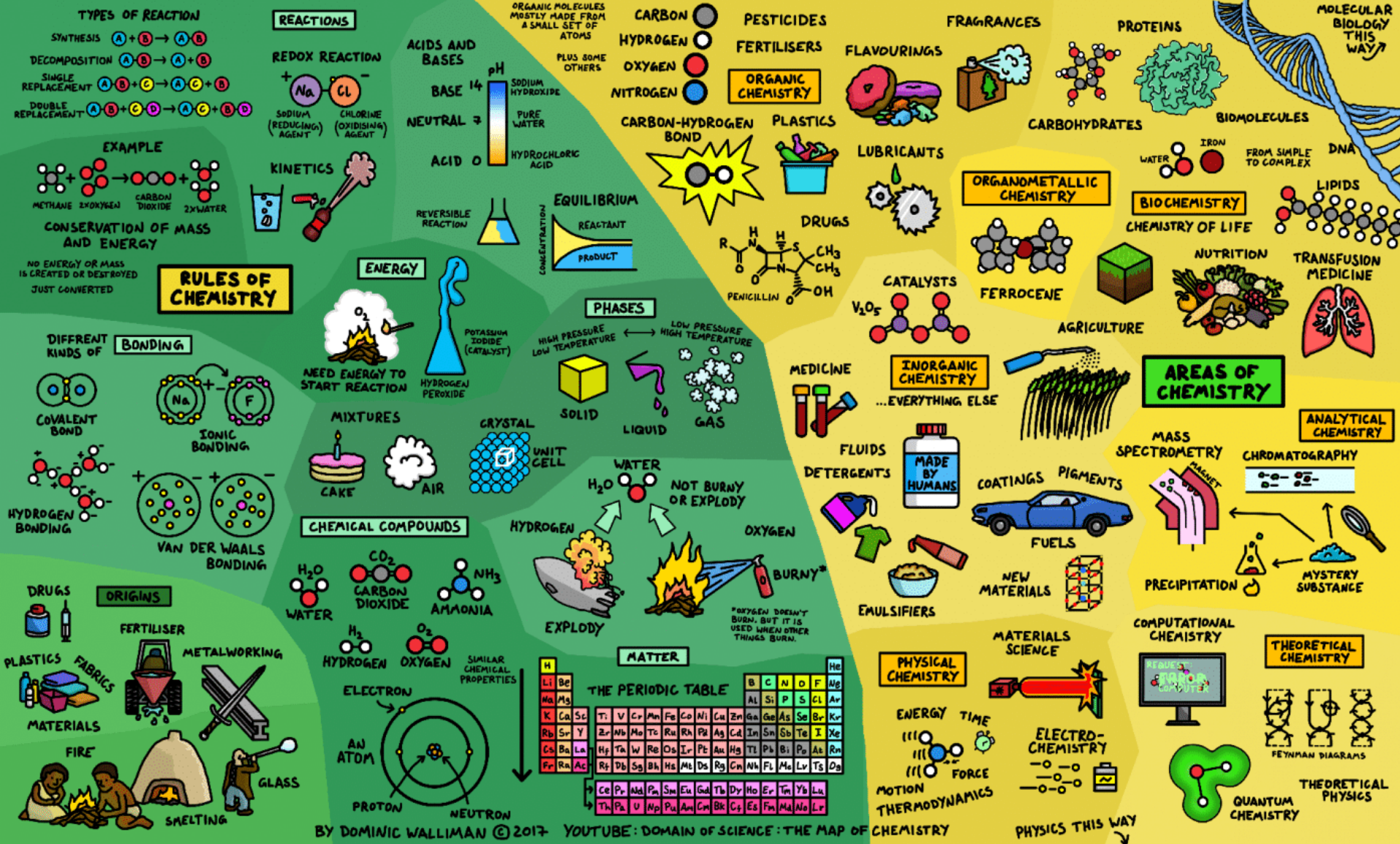
Branches of Science



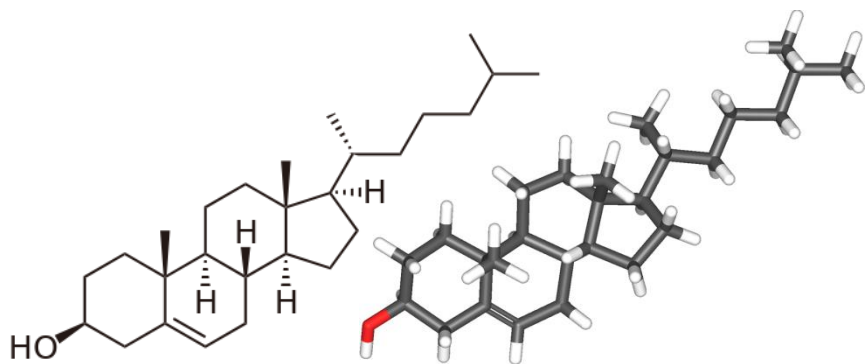
Hierarchy of Science



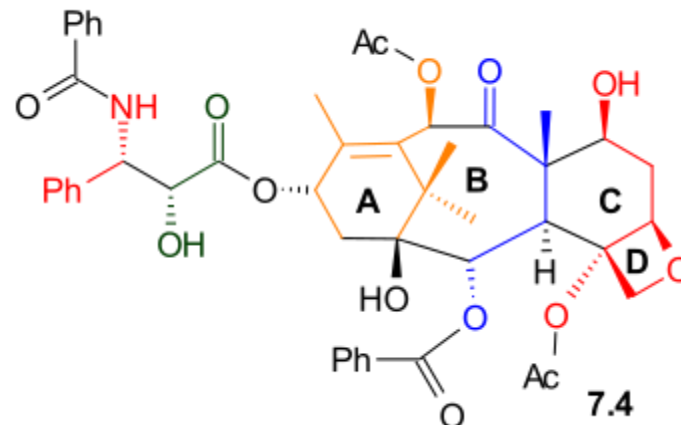
THE MAP OF CHEMISTRY



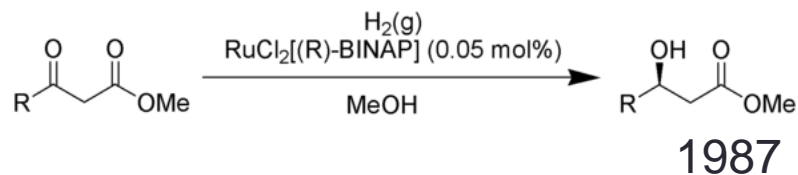
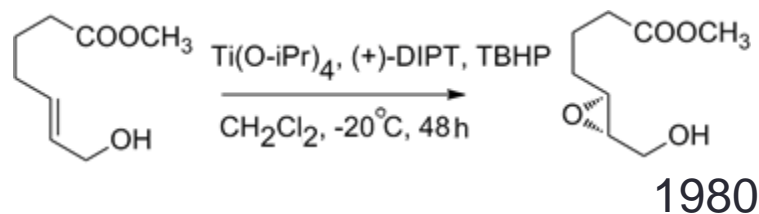
Organic Chemistry



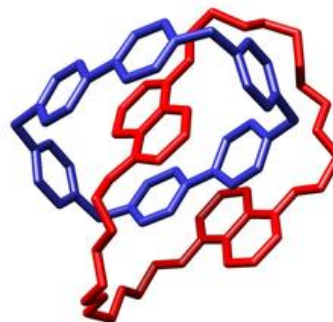
Total synthesis of
Cholesterol 胆固醇, 1951



Total synthesis of
Taxol 紫杉醇, 1994



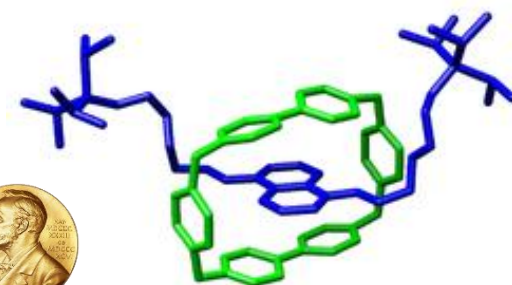
Asymmetric
methodologies



Catenane 索烃

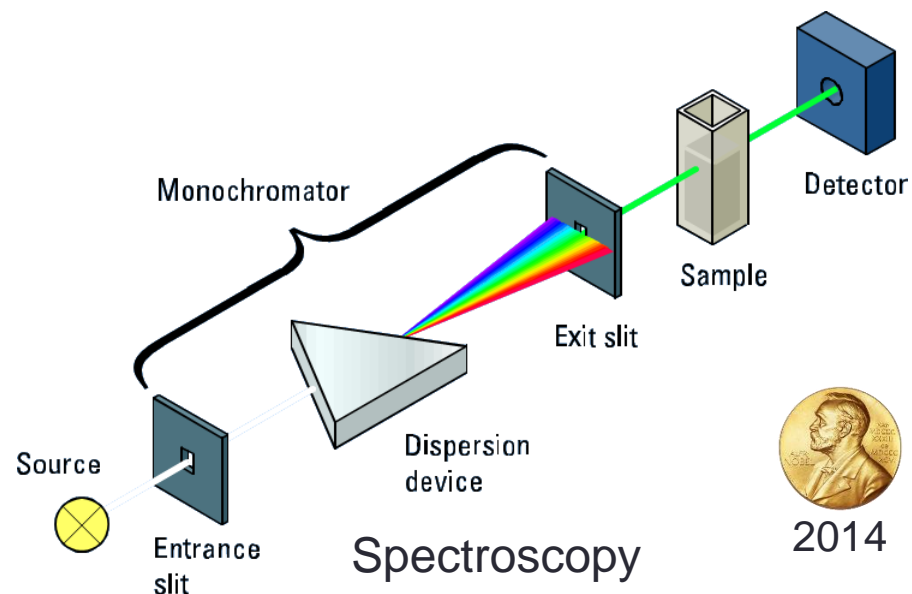


2016

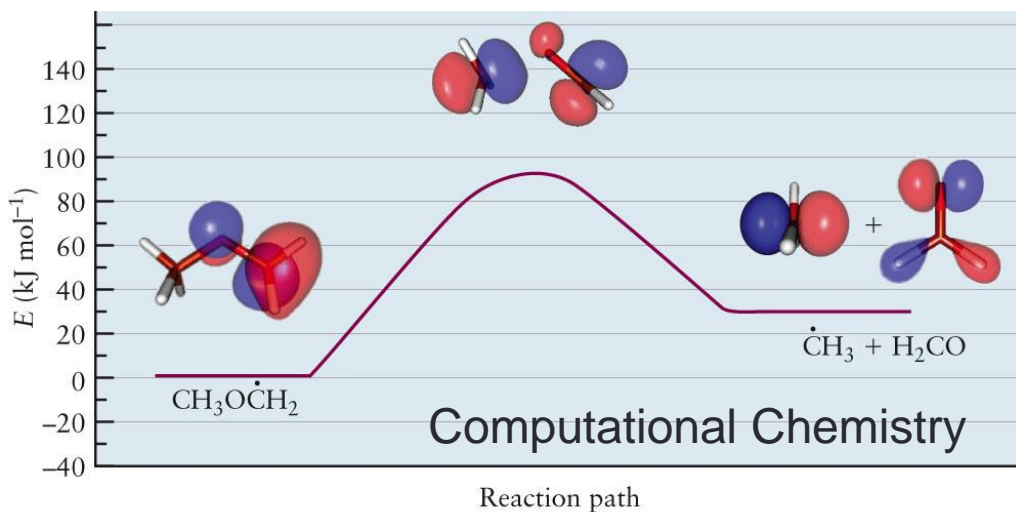


Rotaxane 轮烷

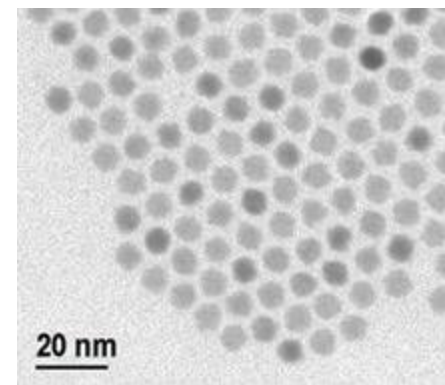
Physical Chemistry



2014



Quantum dots,
since 1980s



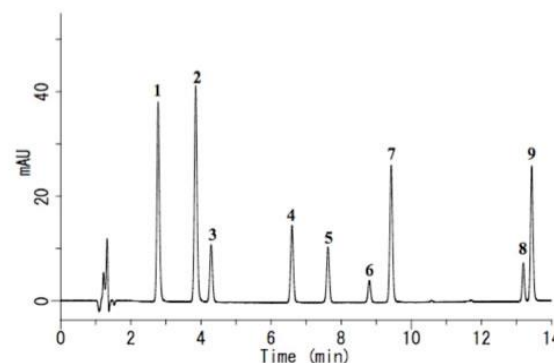
Analytical Chemistry



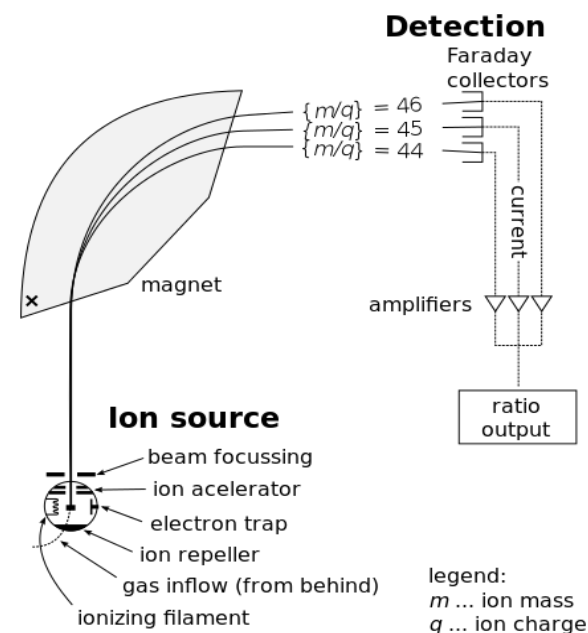
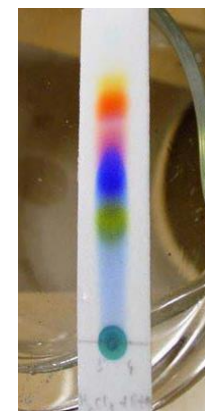
Quantitative analysis,
since 1900s



Nuclear magnetic resonance
核磁共振 (NMR), since 1945

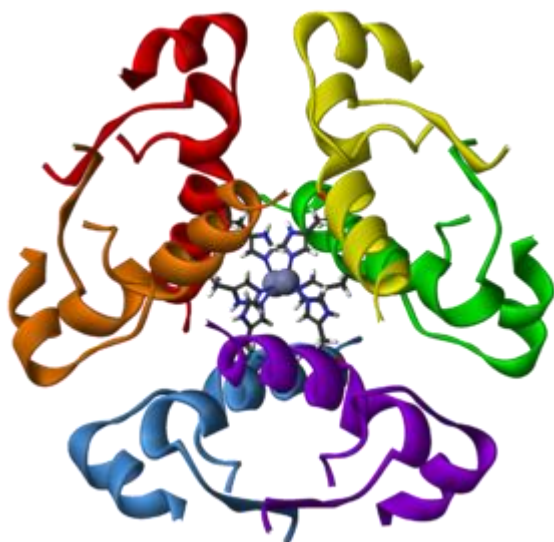


Chromatography 色谱, since 1940s



Mass spectroscopy 质谱,
since 1918

Biochemistry

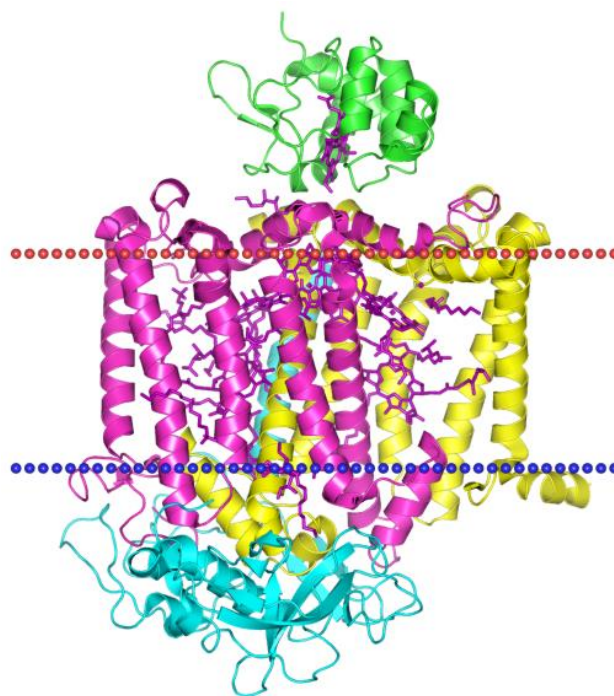


Insulin 胰岛素

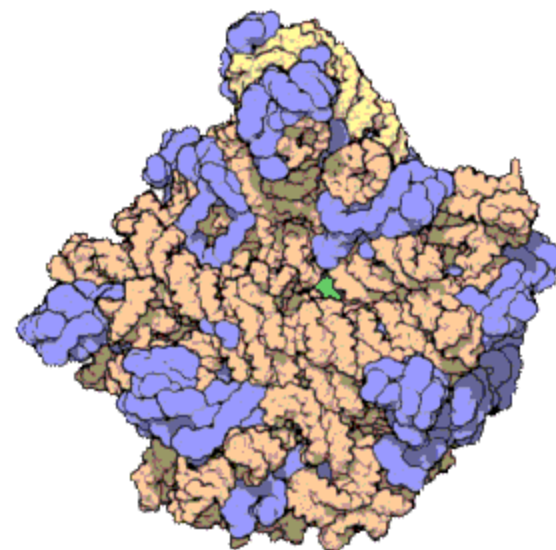
Structure: Early 1950s

Synthesis: Early 1960s

Crystal: 1965 by **SIBS**

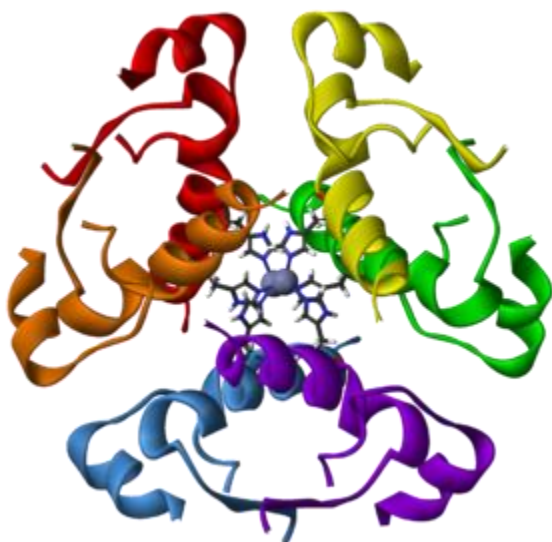


Bacterial photosynthetic
reaction center, 1982



Ribosome 核糖体
(large subunit), 2000

Biochemistry



Insulin 胰岛素

Structure: Early 1950s

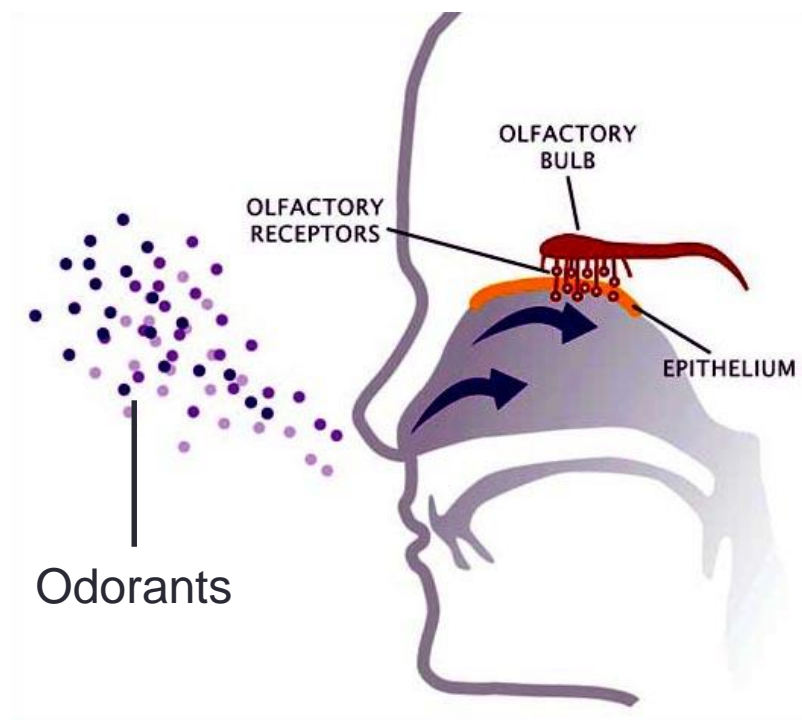
Synthesis: Early 1960s



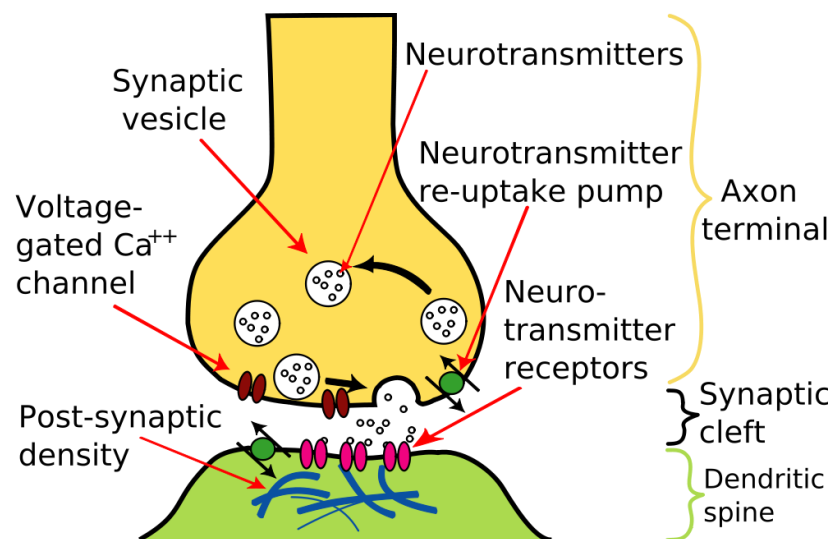
Crystal: 1965 by **SIBS**

Chemistry and Biology

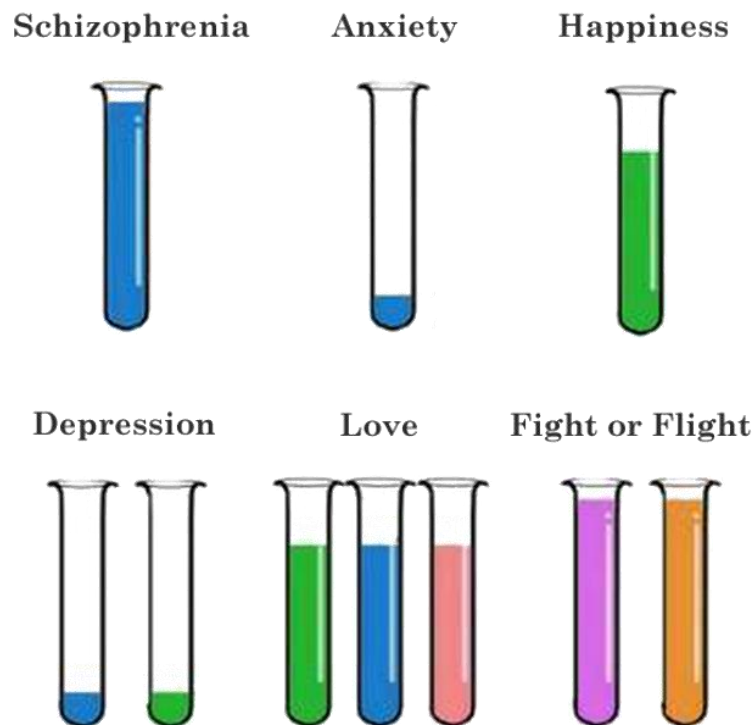
Artificial olfaction & gustation








Chemistry of neurotransmission

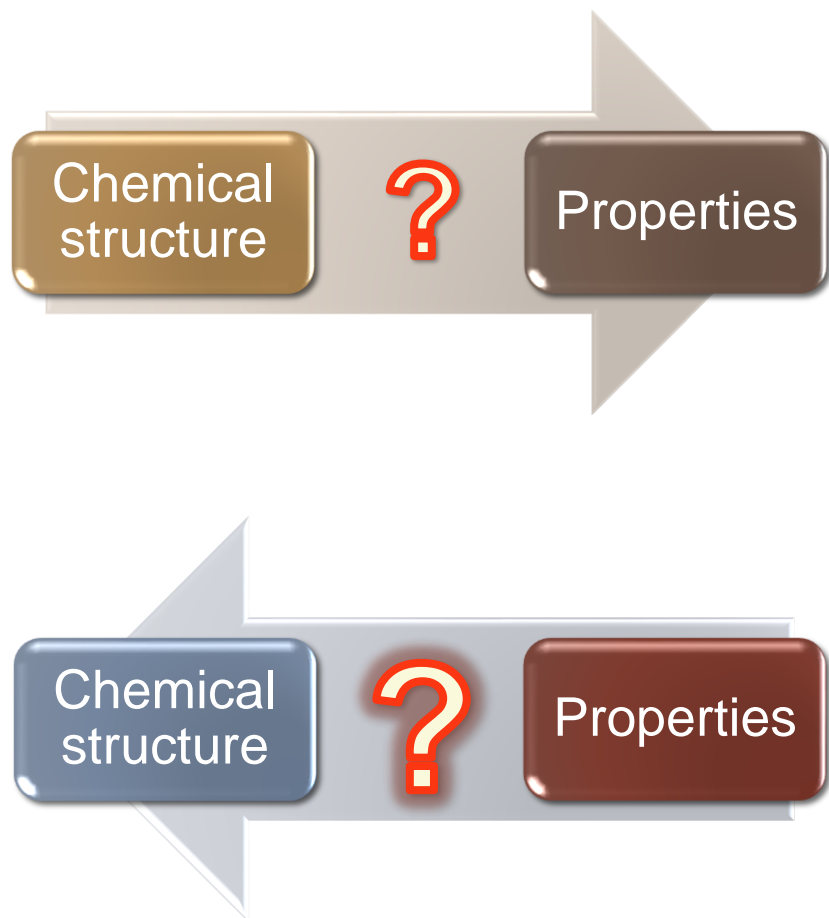


Chemistry and Biology



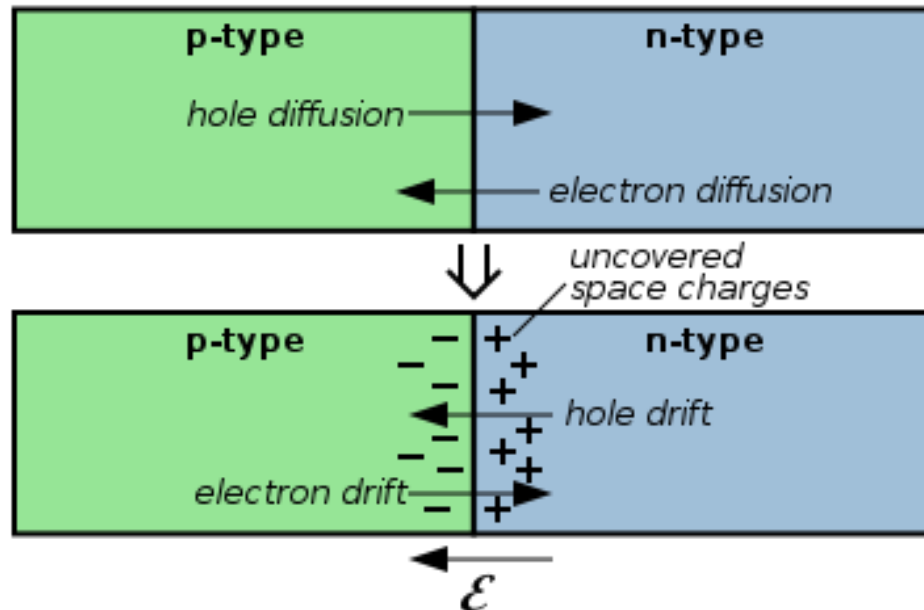
-  - Dopamine 多巴胺
-  - Serotonin 血清素, 5-羟色胺
-  - Oxytocin 催产素
-  - Norepinephrine 去甲肾上腺素
-  - Epinephrine 肾上腺素

Chemistry and Materials Science

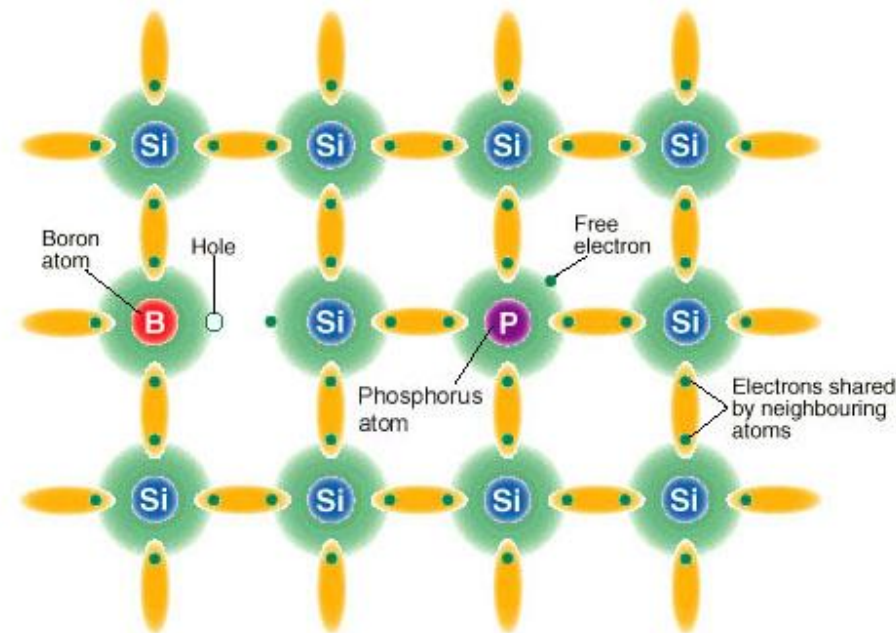


Chemistry and Physics

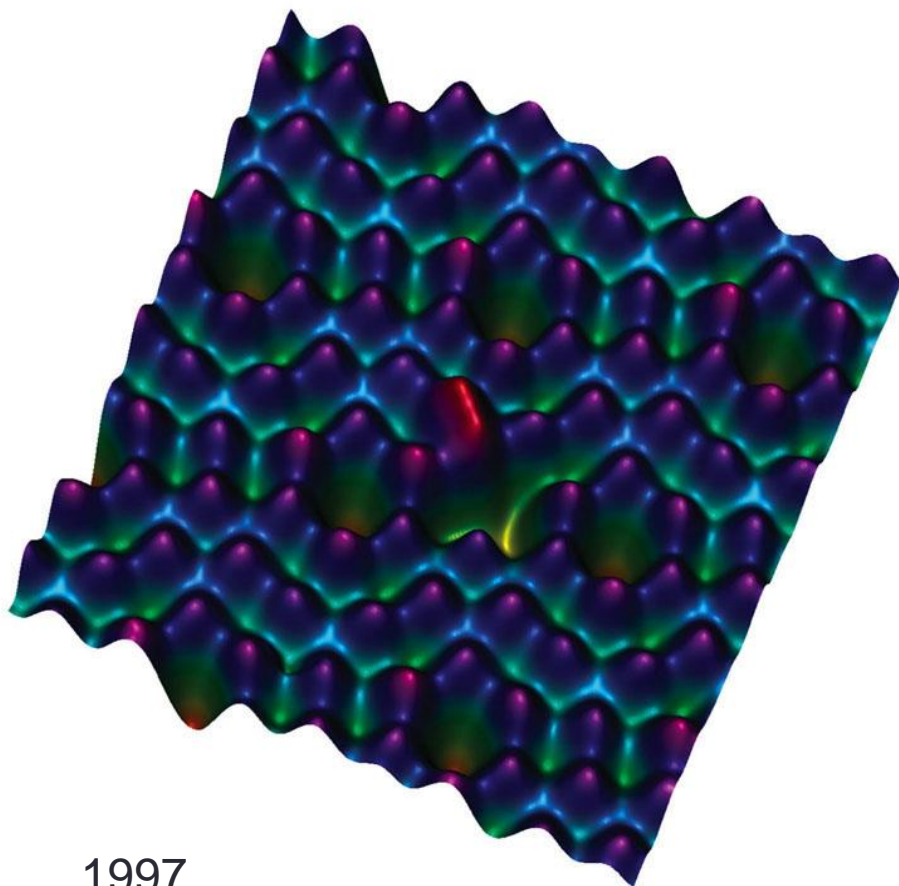
Physics of p-n junction



Chemistry of p-n junction

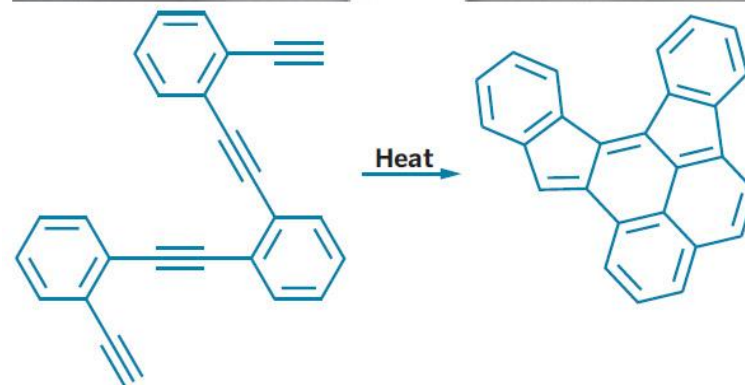
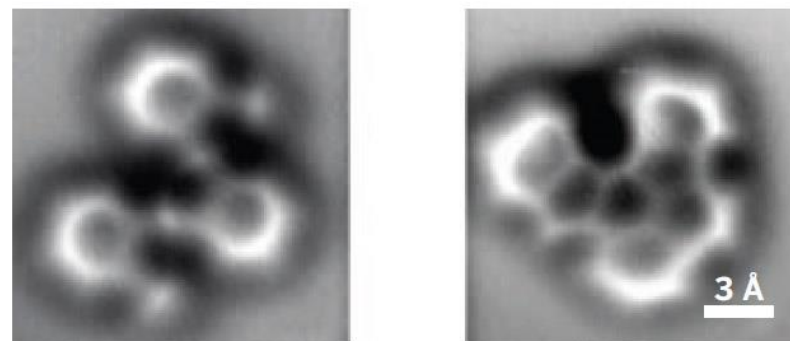


Focuses on Atoms and Bonds



1997

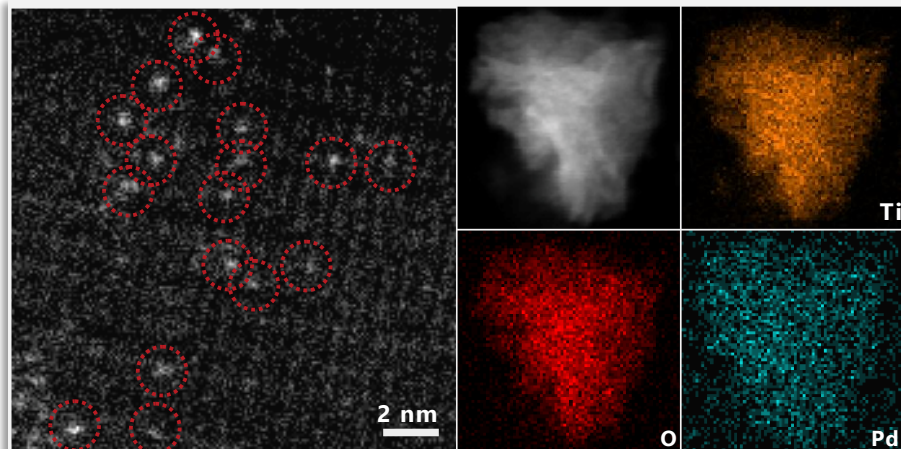
Individual atoms on Si surface



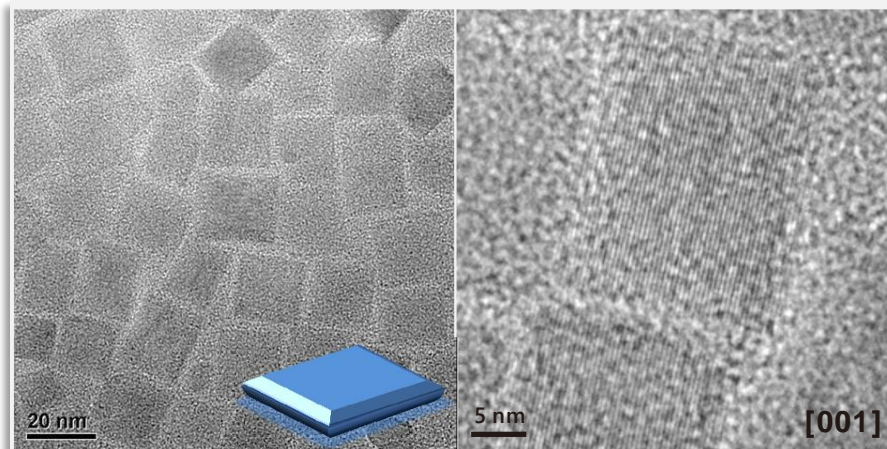
2013

The making of bonds

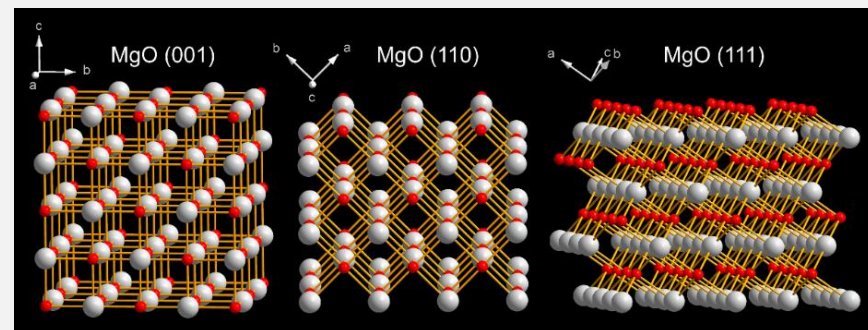
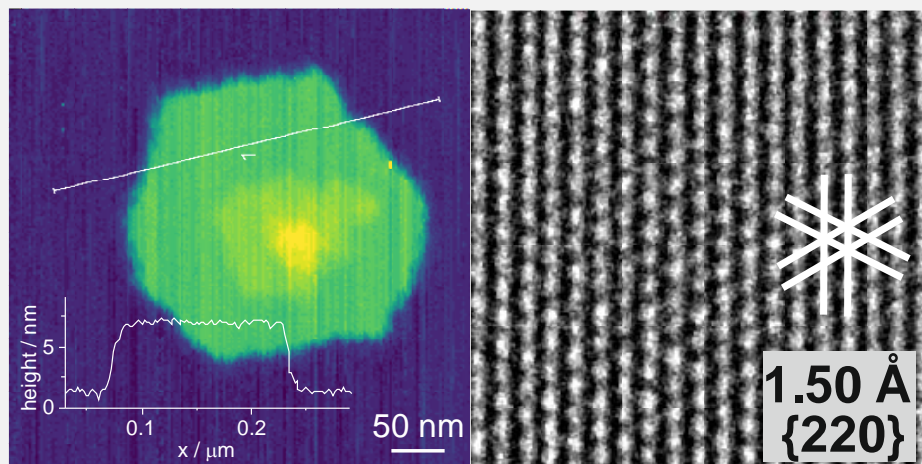
What I did...



P. Liu, et al. *Science*, **2016**, 352, 797

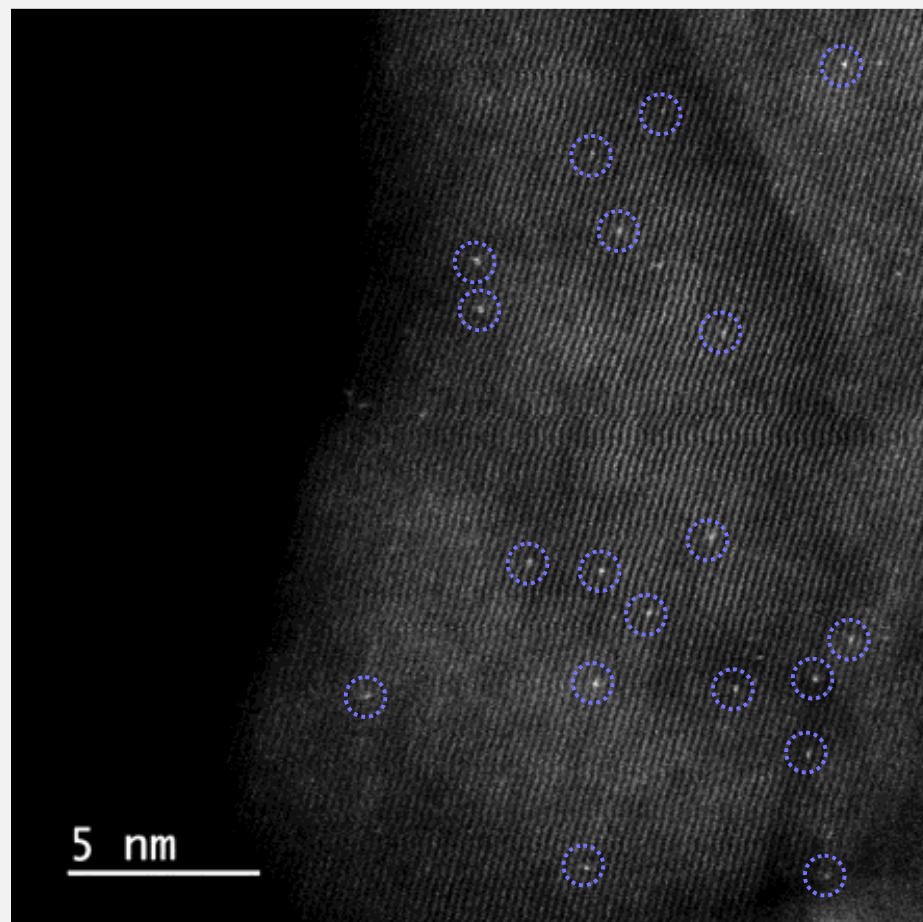
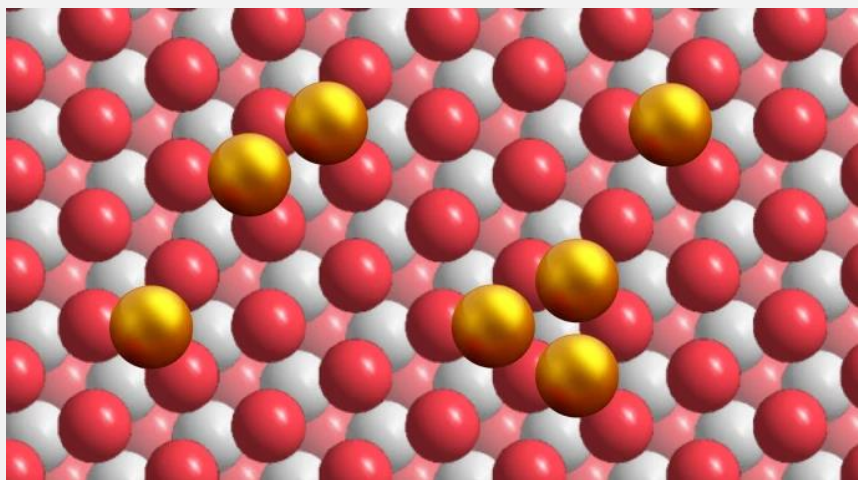
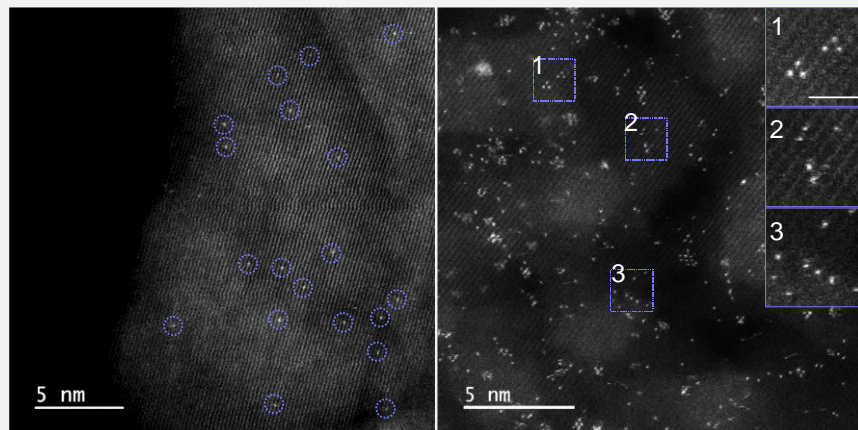


P. Liu, et al. *Chin. J. Catal.* **2017**, 38, 1574



P. Liu*, et al. *Angew. Chem. Int. Ed.*, **2021**, 60, 3254

What I did...

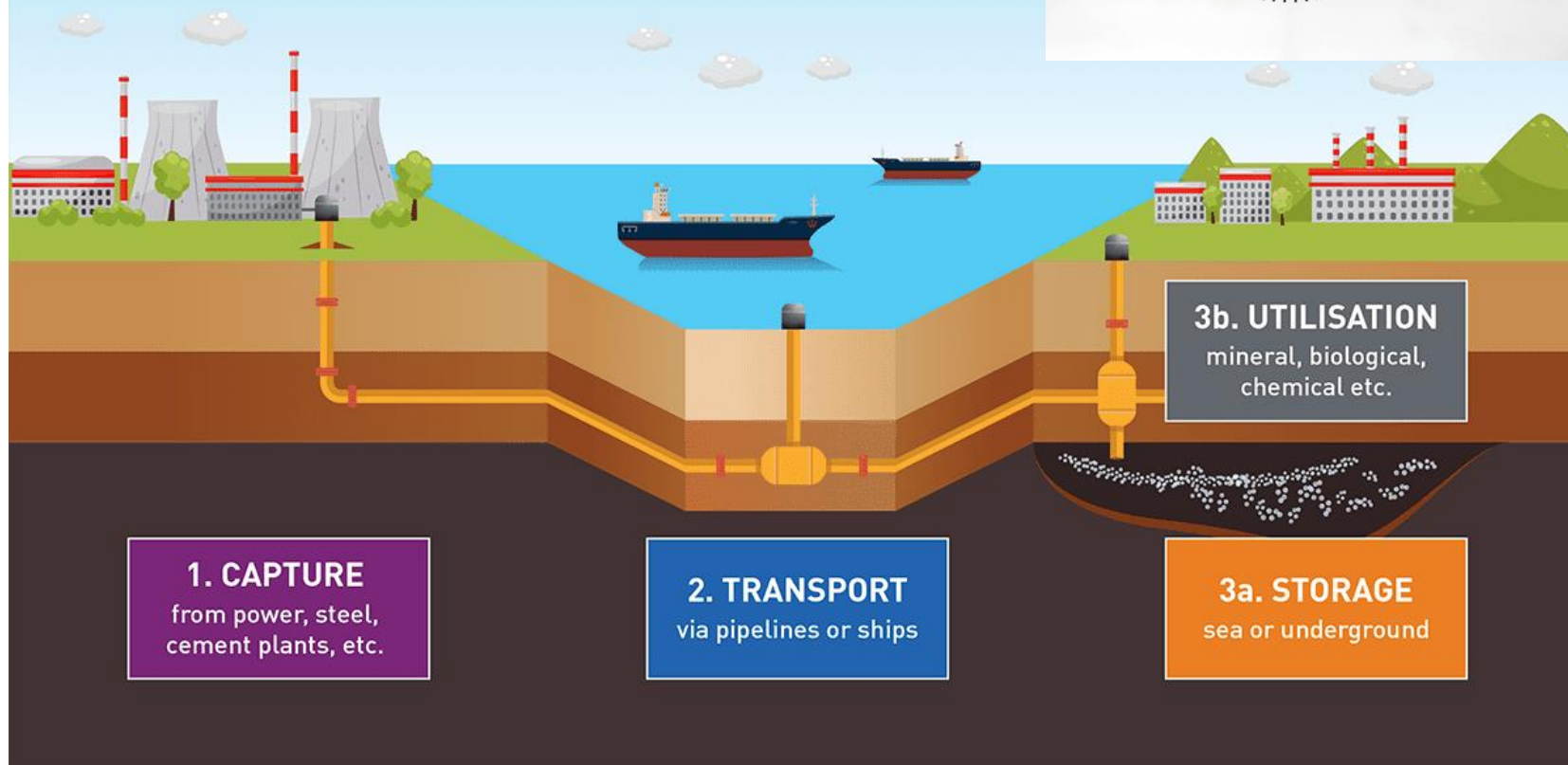


P. Liu*, *et al.* *Nature Catalysis*, **2021**, 4, 968

Energy and environment



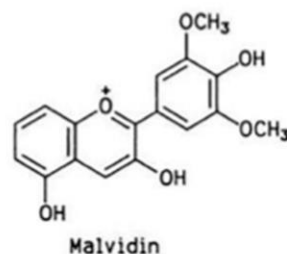
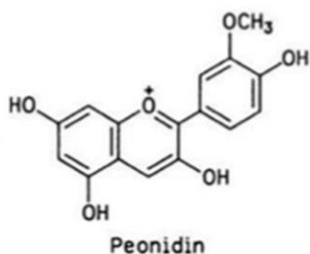
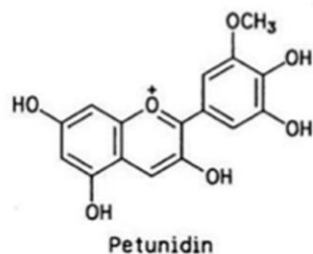
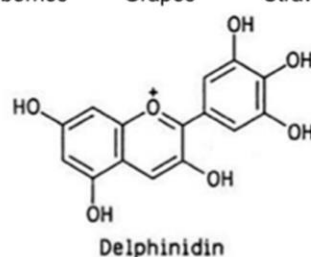
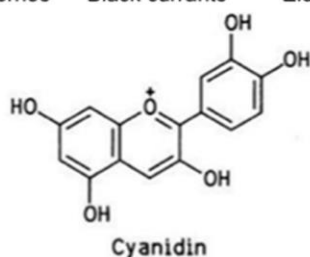
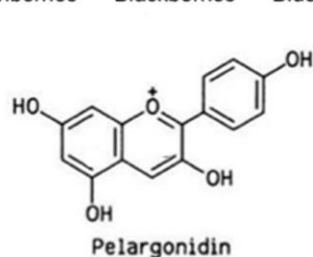
The CCUS process



Outline

- What is Chemistry
- What has chemistry achieved and what hasn't ?
- What do we benefit from learning chemistry ?

“抗氧化”保健品不能抗衰老！



Pelargonidin:

- Strawberries
- Radishes

Cyanidin:

- Black currants
- Raspberries
- Elderberries

Delphinidin:

- Black currants
- Blueberries

Petunidin:

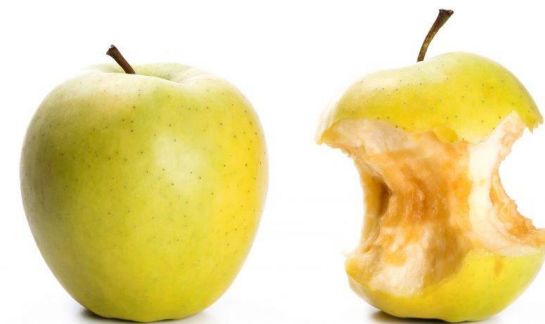
- Blueberries

Peonidin:

- Cranberries

Malvidin:

- Blueberries
- Grapes



Antioxidants 2016, 5(4), 37;
<https://doi.org/10.3390/antiox5040037>

- 在体外具有抗氧化性
- 在体内会被代谢掉，缺乏与人类健康相关性的证据
- 从2010年起仅从体外实验中得出的ORAC（氧化抗自由基吸收能力）不再被认为与人类饮食或生物学有关

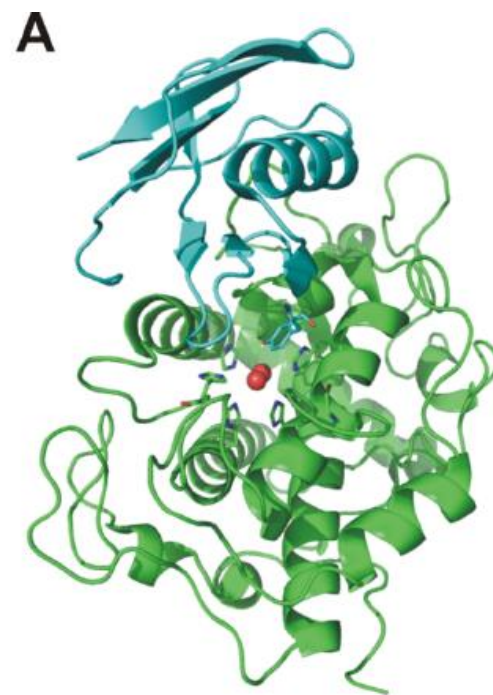
一些美白产品有潜在风险

- 黑色素的形成: 酪氨酸在酪氨酸酶的催化作用下, 与氧自由基经复杂的氧化、聚合, 最后合成黑色素。



氢醌: 对苯二酚

- 作用于酪氨酸酶, 影响黑色素形成
- 与羟基乙酸共用, 去除皮肤角质
- 1982年FDA批准添加
- 致癌风险, 2006年FDA撤销批准



Chemistry: The Central Science

Next chapter: Chemical formulas & nomenclature

Reading: OGB8 §1.2, 1.3, 1.6, §2, §3.12-13

