CHEMISTRY: THE CENTRAL SCIENCE

General Chemistry I, Lecture Series 1 Pengxin Liu

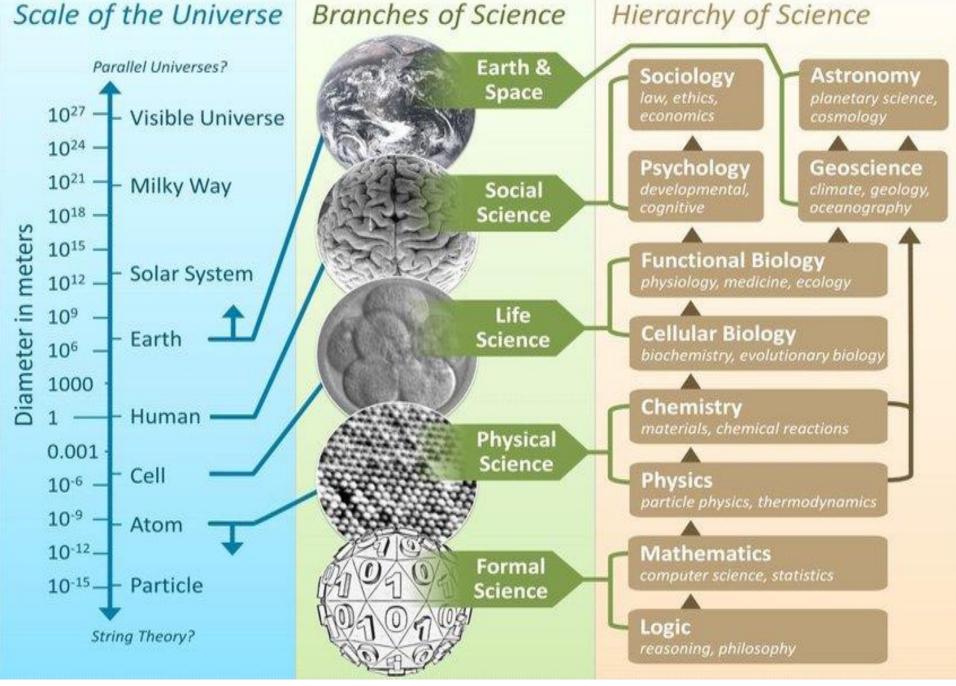


Outline

- 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)



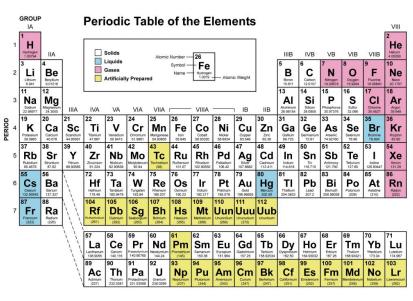
https://en.wikipedia.org/wiki/Branches_of_science

THE MAP OF CHEMISTRY ORGANIC MOLECULES MOSTLY MADE FROM A SMALL SET OF MOLECULAR CARBON TYPES OF REACTION REACTIONS **PESTICIDES** FRAGRANCES BIOLOGY **PROTEINS** SYNTHESIS A+B - AB HYDROGEN O ACIDS AND FERTILISERS FLAVOURINGS DECOMPOSITION (A-18) - (A+18) REDOX REACTION DXYGEN SINGLE REPLACEMENT (A.B.+C) + (B.+C)+ ORGANIC NITROGEN (CHEMISTRY POUBLE REPLACEMENT A B+ 60 + A 6+ B D BIDMOLECULES NEUTRAL PLASTICS CARBON-HYDROGEN CARBOHYDRATES EXAMPLE LUBRICANTS ORGANOMETALLIC CHEMISTRY EQUILIBRIUM BIOCHEMISTRY DRUGS CHEMISTRY OF LIFE CONSERVATION OF MASS AND ENERGY NUTRITION TRANSFUSION ENERGY MEDICINE RULES OF CATALYSTS JUST CONVERTED FERROCENE CHEMISTRY PENICILLIN PHASES AGRICULTURE BONDING INORGANIC MEDICINE AREAS OF NEED ENERGY TO START REACTION CHEMISTRY ... EVERYTHING ELSE MIXTURES ANALYTICAL CRYSTAL LIQUID CHEMISTRY MASS FLUIDS SPECTROMETRY CHROMATOGRAPHY DETERGENTS NOT BURNY OR EXPLODY CHEMICAL COMPOUNDS DXYGEN FUELS VAN DER WAALS BONDING MYSTERY PRECIPITATION SUBSTANCE ORIGINS EMULSIFIERS COMPUTATIONAL EXPLODY MATERIALS CHEMISTRY THEORETICAL METALWORKING SCIENCE MATTER CHEMISTRY SIMILAR CHEMICAL PROPERTIES PHYSICAL CHEMISTRY **ELECTRON** ENERGY MATERIALS ELECTRO-CHEMISTRY ATOM -0 -0 IIIO " THEORETICAL MOTION THERMODYNAMICS CHEMISTRY PHYSICS THIS WAY

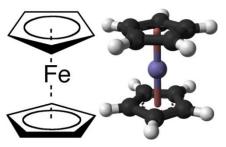
BY DOMINIC WALLIMAN @ 2017 YOUTUBE: DOMAIN OF SCIENCE: THE MAP OF CHEMISTRY

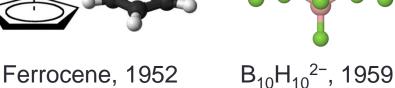
cr. DominicWalliman

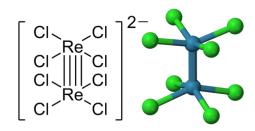
Inorganic Chemistry



Periodic Table, 1869 Rhenium (Re 铼), 1925 Technetium (Tc 锝), 1937 Promethium (Pm 钷), 1947







[Re₂Cl₈]²⁻, 1965

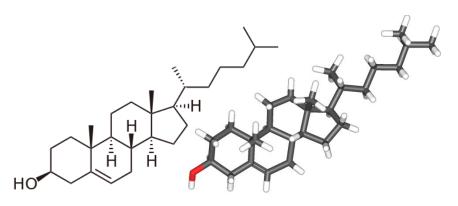
Rare earths 稀土





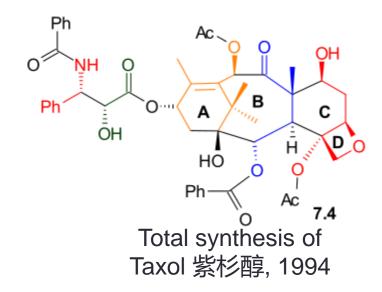


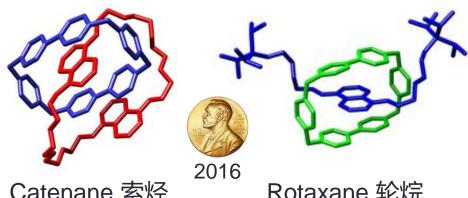
Organic Chemistry



Total synthesis of Cholesterol 胆固醇, 1951

methodologies

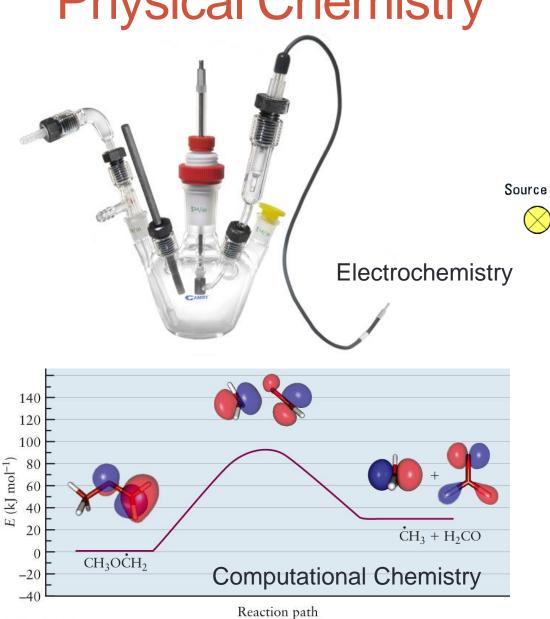


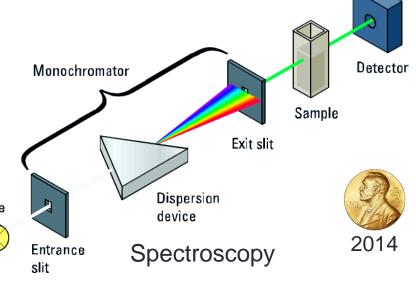


Catenane 索烃

Rotaxane 轮烷







Quantum dots, since 1980s



20 nm

Analytical Chemistry

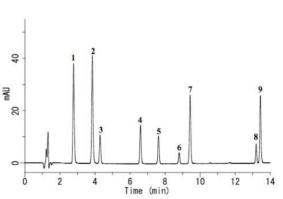


Quantitative analysis, since 1900s

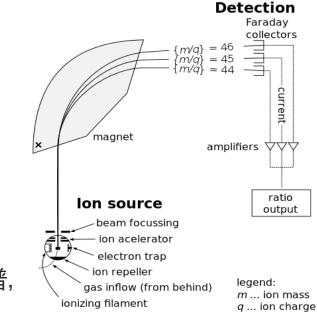


Nuclear magnetic resonance 核磁共振 (NMR), since 1945

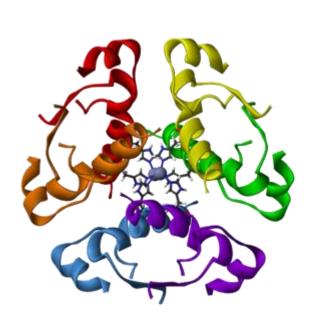
Mass spectroscopy 质谱, since 1918



Chromatography 色谱, since 1940s

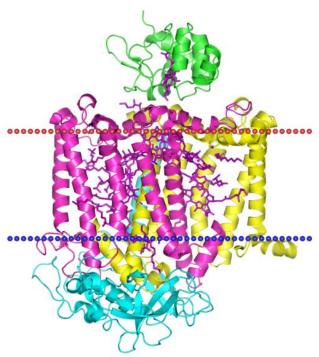


Biochemistry

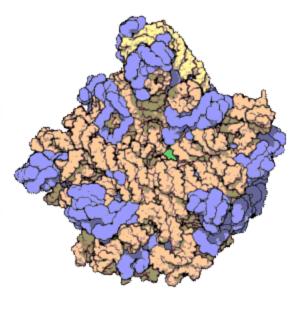


Insulin 胰岛素 Structure: Early 1950s Synthesis: Early 1960s

Crystal: 1965 by SIBS

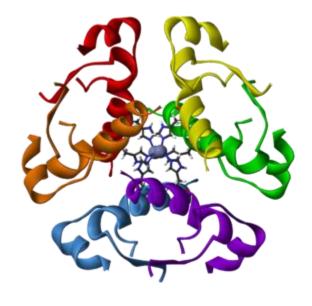


Bacterial photosynthetic reaction center, 1982



Ribosome 核糖体 (large subunit), 2000

Biochemistry

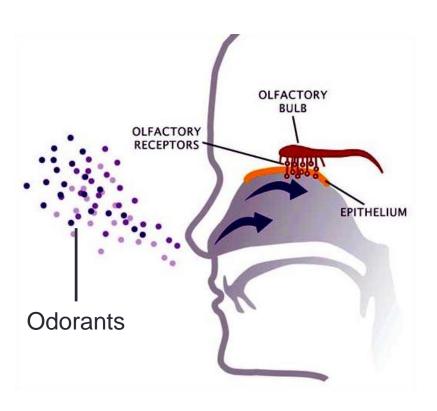


Insulin 胰岛素 Structure: Early 1950s Synthesis: Early 1960s

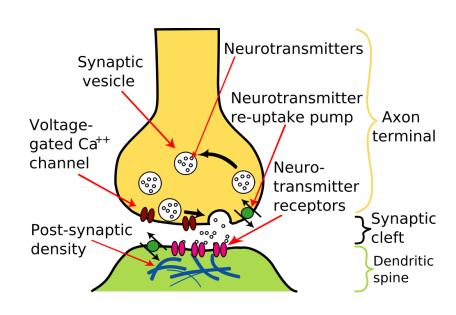
Crystal: 1965 by SIBS

Chemistry and Biology

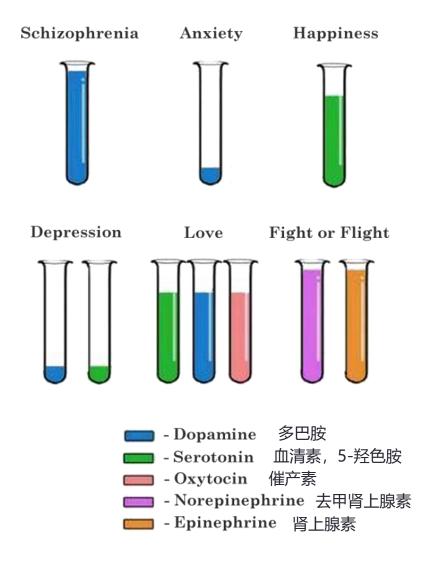
Artificial olfaction & gustation



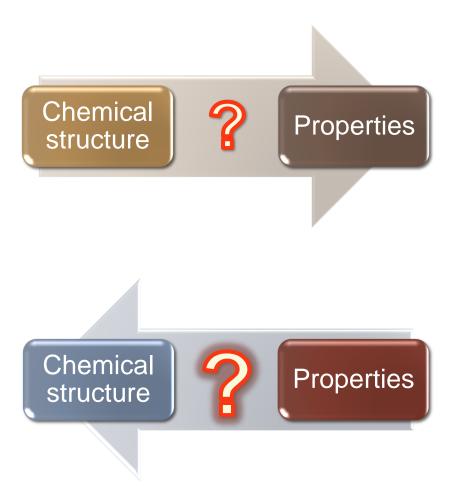
Chemistry of neurotransmission



Chemistry and Biology



Chemistry and Materials Science

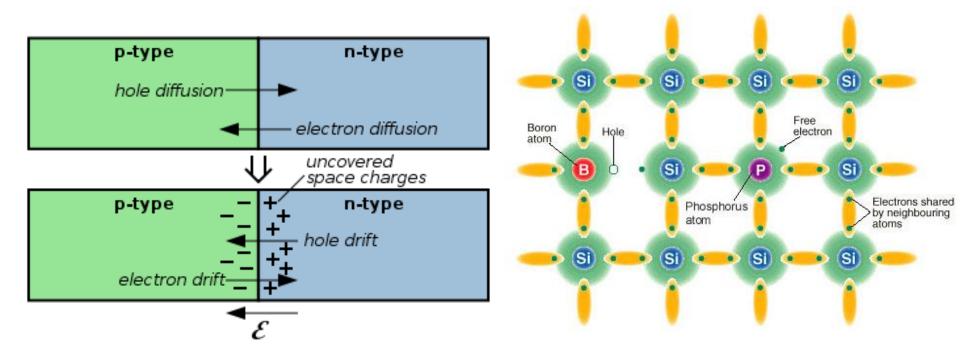




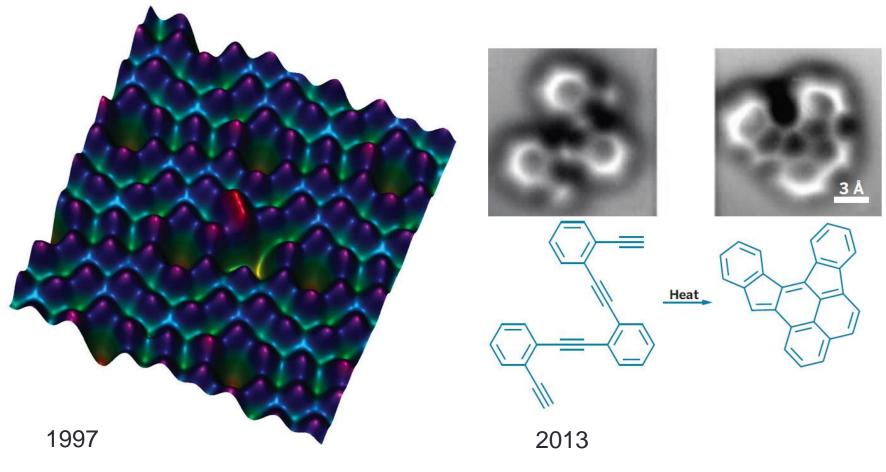
Chemistry and Physics

Physics of p-n junction

Chemistry of p-n junction



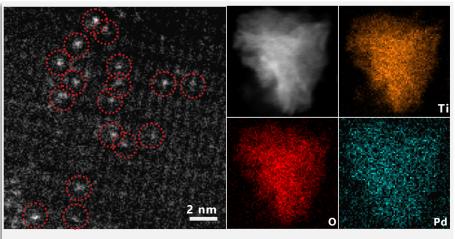
Focuses on Atoms and Bonds



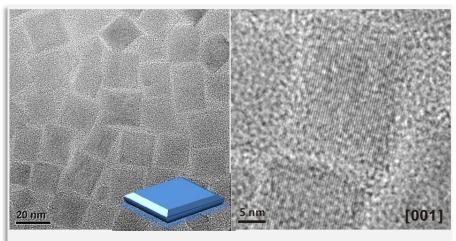
Individual atoms on Si surface

The making of bonds

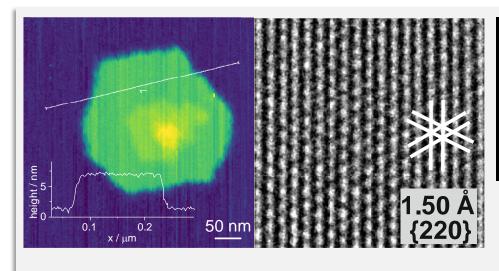
What I did...

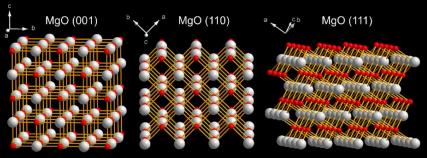


P. Liu, et al. Science, **2016**, 352, 797



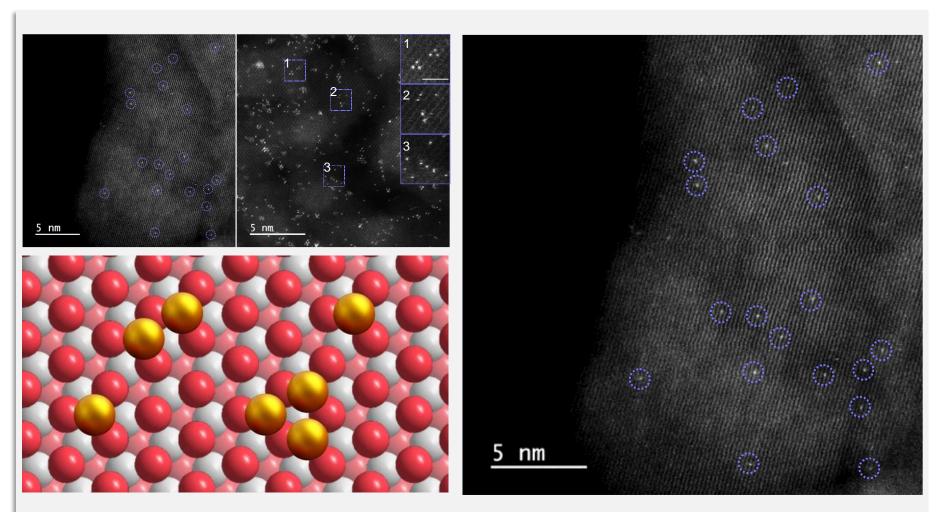
P. Liu, et al. Chin. J. Catal. 2017, 38, 1574





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

What I did...



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

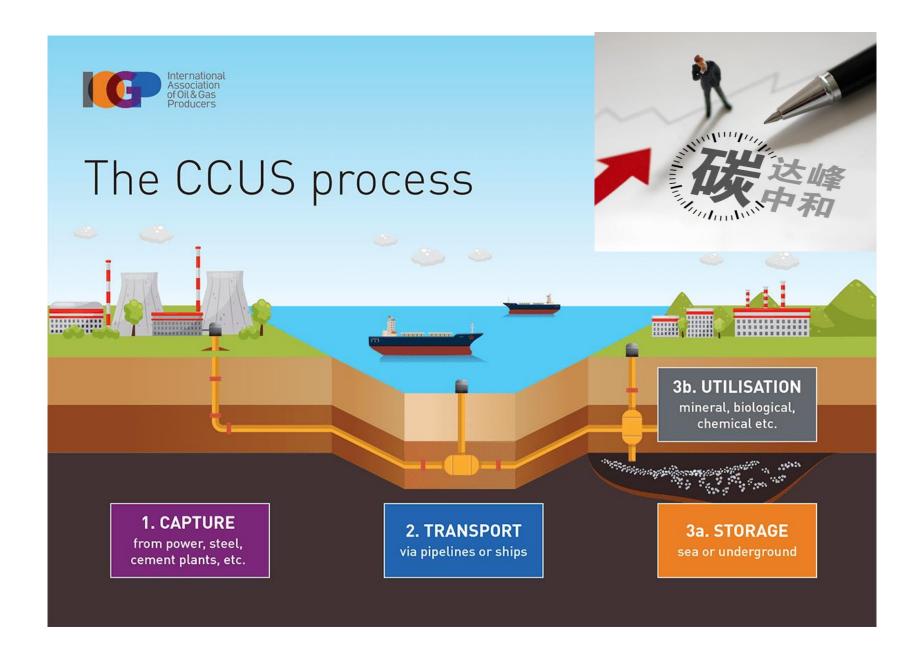
Energy and environment









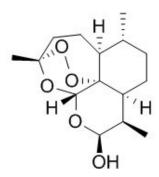


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中医 or 西医?

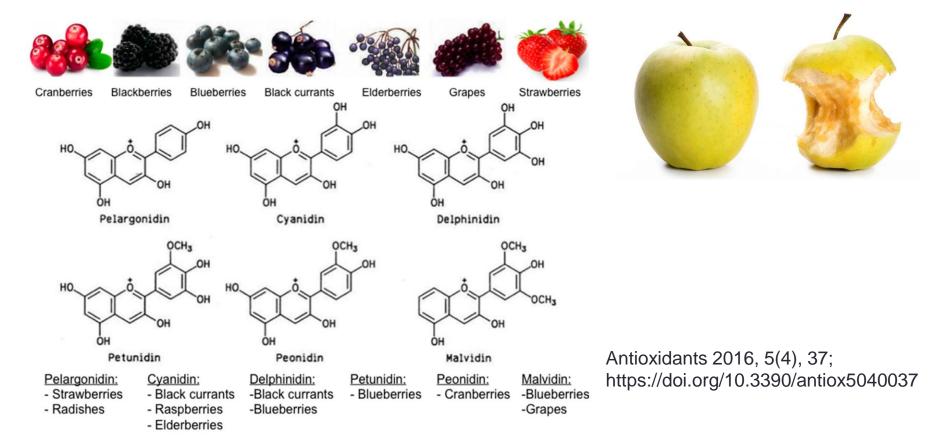
中医现代化!现代医学、药物化学、天然产物化学、药代动力学、生物医学工程、放射学.....







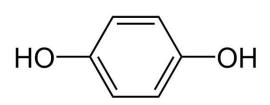
"抗氧化"保健品不能抗衰老!



- 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

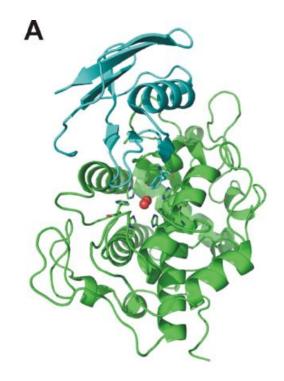
一些美白产品有潜在风险

• 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

