



THREE MOLECULES

And their origins and effects
on society

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GCSC Honors Program

Introduction

In this project, I explored the chemistry of three molecules, their discovery, and effects on society. The molecules were chosen after reading “Napoleon’s Buttons: How 17 Molecules Changed History ” by Jay Burreson and Penny Le Couteur. There are many molecules discovered through the years that have changed history and stimulated advancements in medicine, research, and production. The three molecules I will be discussing are silk molecules, dye molecules, and isoprene (or rubber) molecules. I will discuss their discovery and development, their chemical and physical properties, and the mechanisms by which they spread across different industries and various parts of the world. Their impacts on society and contributions to the advancement of civilization will also be discussed.



Silk Molecules

- The making of silk began in China when silkworm moths would lay thousands of eggs that produced several silkworms which would feed on Mulberry Leaves to make silk¹.
- After it had been discovered, the making of silk disseminated quickly across China and it was seen as a sign of royalty of the higher class¹. It was a greatly valued item and was used as a means of barter and trade.
- Initially, the creation of silk was kept in secrecy throughout China, but eventually silk production made its way to the West¹. This was a critical precursor for the silk industry to flourish.



<https://medium.com/@aquilaeagle/why-silk-is-so-expensive-aquila-ae5b3cee8e16>

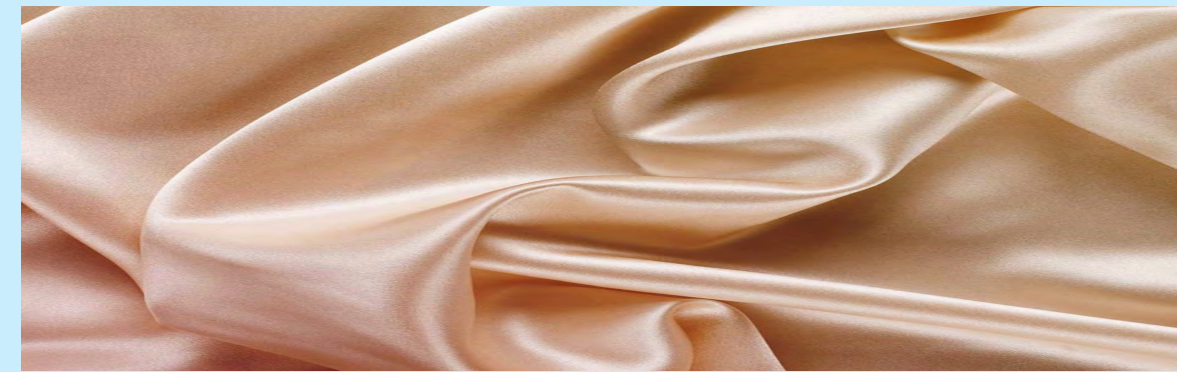


<https://www.vice.com/en/article/8qxjwp/silkworms-will-mass-produce-spider-silk-because-spiders-wont>

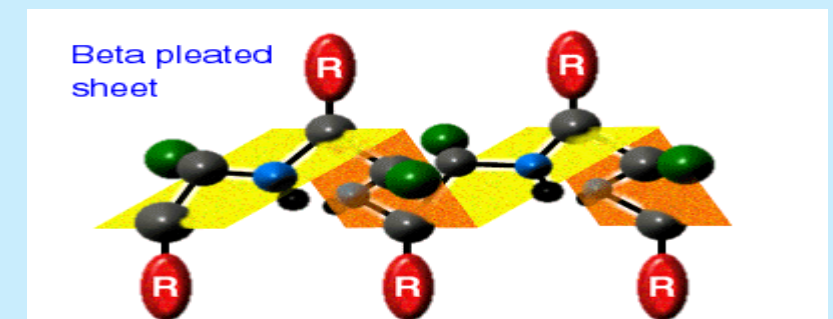
Silk Molecules

Chemistry

- Silk possesses a pleated sheet structure which gives it many of its characteristic properties¹.
- The protein chains remain close together due to the arrangement giving silk a uniform structure¹.
- One of Silk's most important applications was as a form of currency along the Silk Road, which opened new trade routes, initiated commerce between nations and allowed for the spread of ideas and inventions.
- It connected China with The Middle East and parts of Europe which allowed for the export of many things².
- Two of the most influential items to be brought across the silk road by China were paper and gunpowder².



<https://medium.com/@aquilaeagle/why-silk-is-so-expensive-aquila-ae5b3cee8e16>



<http://www.brooklyn.cuny.edu/bc/ahp/SDPS/graphics/BetaPleatedSheet.GIF>

Silk Molecules

- Spices were also exported through the Silk Road and were important in the changing of cuisines in the East and had many medicinal uses³.
- The Silk Road also played a part in carrying goods and ideas to China from the West, including techniques for glass-making.
- Religions made their way across the Silk road along with the passage of goods, spreading traditions and beliefs to many parts of Asia. Christianity spread through China as well as Buddhism which exerted great political influence and appealed to the residents of China³.
- Overall, the Silk road powered by the exchange of silk greatly promoted the exchange of cultures and the circulation of goods between the East and the West.



<https://www.nytimes.com/2020/05/11/t-magazine/the-silk-road.html>



<https://www.grapesandgrains.org/2017/06/the-silk-road-routes-and-history.html>

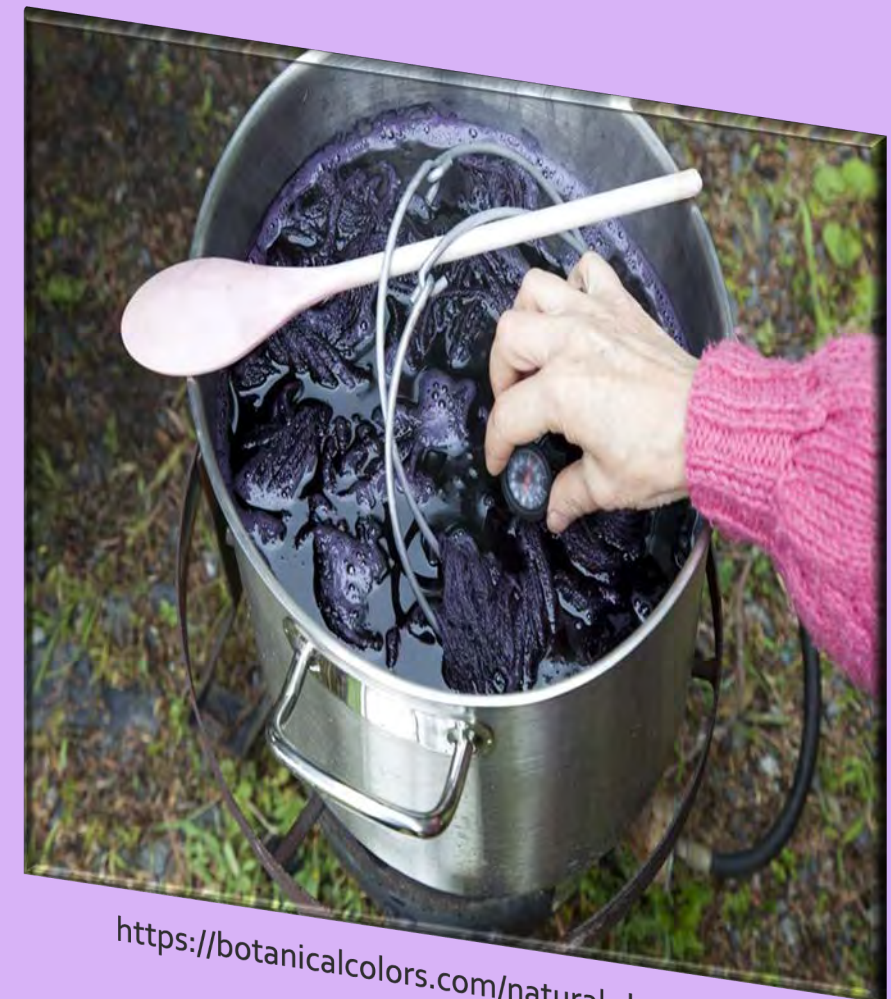
Dye Molecules

Discovery

➤ Dye molecules originated thousands of years ago and were initially obtained from plant sources by extracting leaves, flowers, and berries or from secretions of mollusks and snails¹.



<https://blog.patra.com/2016/09/07/to-dye-for-a-history-of-natural-and-synthetic-dyes/>

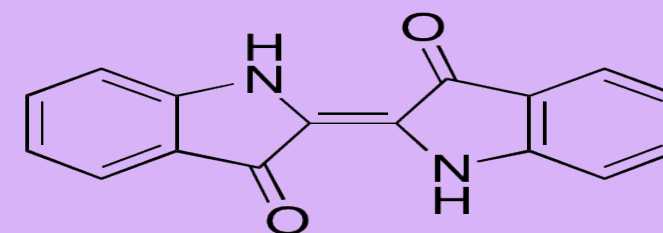


<https://botanicalcolors.com/natural-dye-extract/>

Dye Molecules

Chemistry

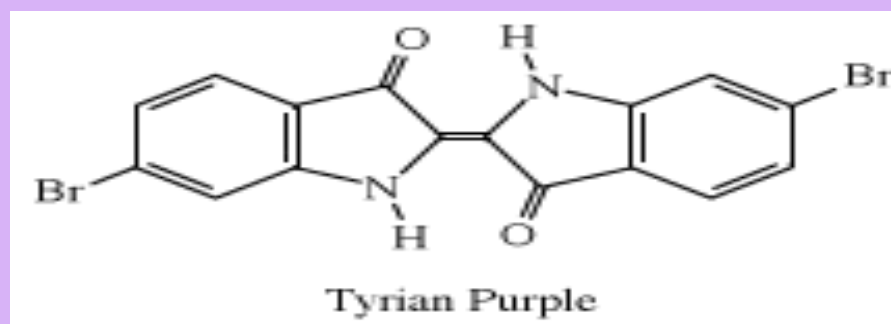
- The making of synthetic dyes came much later in the nineteenth century and it had adverse effects on those whose livelihoods relied on the production of natural dyes¹.



Indigo

<https://chemtips.wordpress.com/2013/05/24/discovered-by-mistake-a-practical-synthesis-of-indigo/>

- The first synthetic dye was manufactured by a college student, William Perkins, in the mid nineteenth century and it changed the dye industry immensely and fueled the dye trade¹. Perkins was attempting to create a malaria resistant drug but instead, accidentally created a mauve dye¹.
- Many major chemical conglomerates began to arise and dominate the making of synthetic dyes. The chemical dyes were utilized for military purposes to create poisonous gases and explosives to support wars¹.



Tyrian Purple

<https://www.britannica.com/science/purple-colour>

Dye Molecules

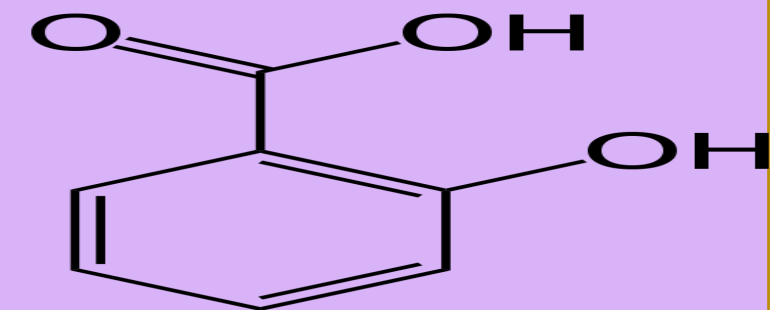
Effects

- Dye molecules have spurred the development of the current biggest chemical companies and have shaped society in many ways.
- They have transformed fashion.
- As demand for dye molecules increased, factories were produced and trade spread. The discovery and creation of mauve by William Perkins led to the founding of the synthetic dye industry.
- Synthetic dyes led to industry growth and as a result financial capital was generated for the formation of antibiotics and other pharmaceutical compounds¹.
- The discovery of aniline dyes helped scientists learn how to purify and separate chemicals which led to the creation of Aspirin and salicylic acid⁴.
- Perkin's advancements with synthetic dyes also allowed scientists to make discoveries in chemotherapy⁴.

Salicylic Acid



<https://crazylittleprojects.com/understanding-different-types-of-fabric/>



<https://www.differencebetween.com/difference-between-salicylic-acid-and-acetylsalicylic-acid/>

Isoprene Molecules

Discovery

- The first evidence of rubber was attributed to Native American tribes and was transported to Europe by Columbus but it proved to have no use¹.
- It began to melt and become smelly during the summer heat.
- Raw sap was experimented with, but it had the same issue.



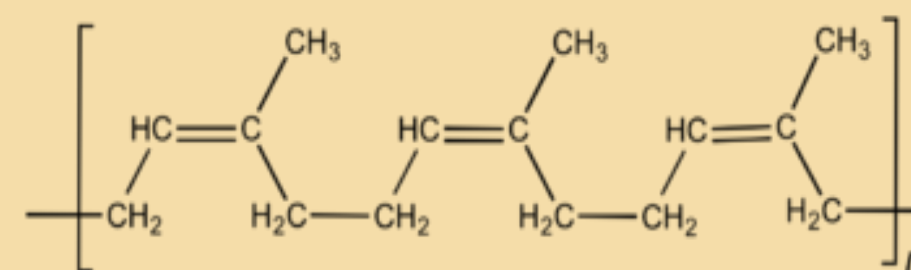
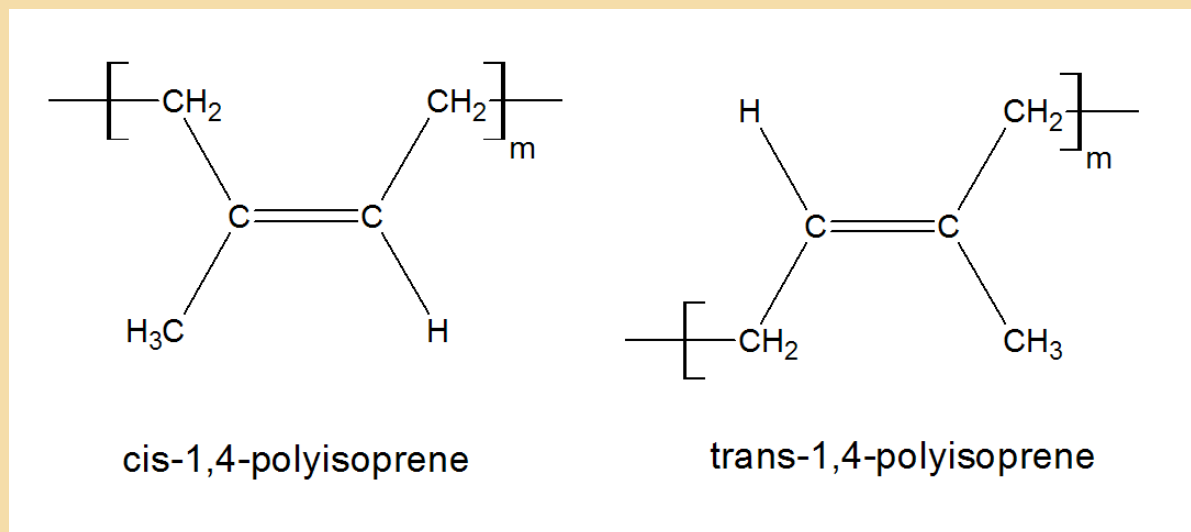
<https://www.databridgemarketresearch.com/covid-19-resources/covid-19-impact-on-rubber-in-the-chemical-and-materials-industry>



Isoprene Molecules

Chemistry

- Rubber is a polymer of Isoprene which can be one of two types of arrangements, cis or trans¹.
- The cis arrangement is necessary for the elastic property of rubber, but sometimes rubber is found in the trans arrangement which has different properties and bonding patterns¹.
- In the mid nineteenth century, rubber substances in the trans arrangement were used for golf balls, but they became brittle in the air and would start to fall apart¹. Scientists began to test different methods to stabilize the rubber and preserve its shape in different weather.
- The first attempts proved to be unsuccessful. Finally American inventor, Goodyear, accidentally discovered a stable and strong substance that could withhold all kinds of weather¹.



<https://en.wikipedia.org/wiki/Isoprene>

Cis chain

Isoprene Molecules

- Rubber has affected both society and the environment in negative and positive ways.
- Lands were colonized and people were held hostage.
- Rubber is an essential component in machines and other technologies like transportation, agricultural mechanization, and space shuttles.



<https://www.giatecscientific.com/education/benefits-to-using-recycled-tires-in-concrete/>

- After Goodyear's discovery, the vulcanized rubber resistant to all temperatures was essential for the industrial revolution⁵.
- It is important in sports because most sports equipment and balls are made of substances of rubber⁵.
- Rubber also plays a vital role in transportation because rubber tires are used in cars and bikes.



<https://monroeaerospace.com/blog/why-airplane-tires-are-made-of-conductive-rubber/>

Conclusion

The three molecules I chose to discuss and research have had immense effects and consequences on society. They have benefited us in ways we don't even realize from the rubber in our tires to the silk and dye used to make our clothes. Despite the advancements they have initiated, the molecules have also had unfavorable effects on the livelihoods of many. Lands were colonized and workers taken as indentured laborers with minimal pay. Scarce resources were depleted and habitats destroyed. The same molecules which provided some with luxurious lifestyles, lead to the downfall of others. Another fascinating thing to consider is the relation of structure and function. It is very apparent in the molecules discussed. Something as small as the placement of a carbon atom can distinguishes a stable arrangement form an unstable one.





I would like to thank FSU for allowing us to discuss our research and information and for providing us with the opportunity to take part in this event.



References

1) Penny LeCouteur Jay Burreson., 1991, Napoleon's buttons.

2) Amanda onion., 2017, Silk road <https://www.history.com/topics/ancient-middle-east/silk-road> Accessed 25 March. 2021

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<https://www.chinahighlights.com/silkroad/significance.htm> Accessed 29 March 2021

4) Bibiana 2018, Mauve.

<https://www.bbvaopenmind.com/en/science/research/mauve-the-history-of-the-colour-that-revolutionized-the-world/#:~:text=While%20still%20a%20teenaged%20student,that%20of%20the%20colour%20mauve>. Accessed 24 March. 2021

5) Ann Somma 2014, vulcanization of rubber. <https://connecticuthistory.org/charles-goodyear-and-the-vulcanization-of-rubber/> Accessed 25 March. 2021