



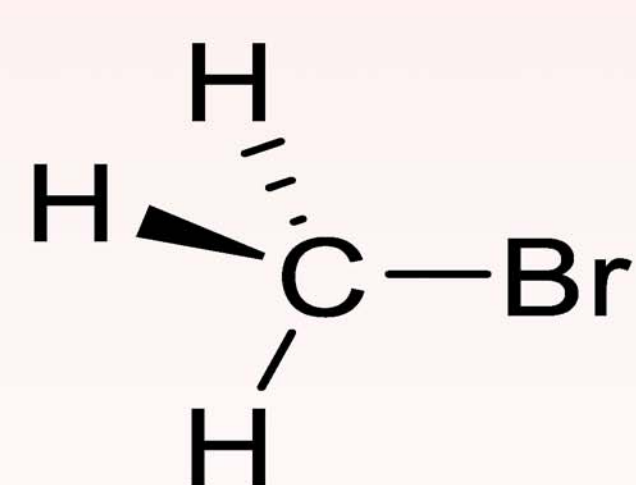
# From Strawberry Fields to Chemistry Class

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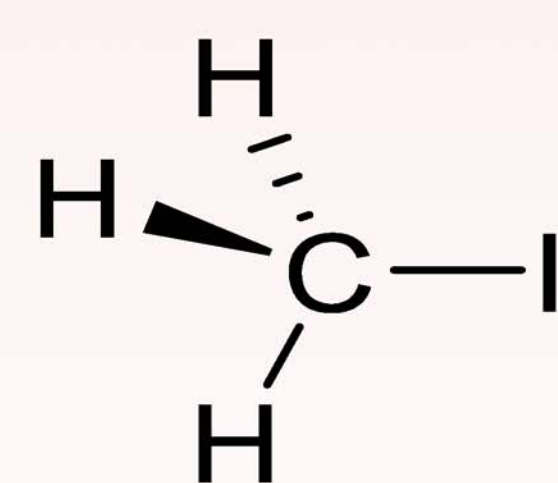
## Introduction

Widely used in law and medical disciplines; case studies are educational tools that allow students to associate classroom content with realistic scenarios. Students use their inductive reasoning skills to analyze a situation that connects to the real world and propose a solution relating to the topics they learned in the classroom. When students apply the general concepts of a topic to a particular incident, it highlights their complete understanding of its process. Research was conducted on two pesticides, methyl iodide and methyl bromide (MeBr), and how they cause harm due to overexposure. The specific chemical reactions the pesticides undergo are known as substitution reactions, specifically SN<sub>2</sub>.

## Structures



**MeBr**



**MeI**

Figure 1. The structure of methyl bromide (MeBr) is shown on the left. The structure of methyl iodide (MeI) is shown on the right.

## History and Controversy

Methyl bromide was introduced as a fumigant and insecticide in 1961 in the United States and was subjected to a phase out by the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987.

Under the Protocol's guidelines, the use of MeBr was to cease by 2005, the same year as its original ban. However, because farmers in California relied on the economic stability the pesticide provided, an extension was granted until 2015, when an alternative was to be introduced. In 2010 Methyl Iodide was registered as an alternative, but overwhelming opposition from both the general public and science communities inhibited vast use in the strawberry fields.

Methyl bromide is still in use today because the harm of the methyl iodide replacement surpassed that of the original pesticide quickly. The controversy between the farmers that rely on the pesticides and the Environmental Protection Agency will be used to guide the conversation in the case study for the students.

## SN<sub>2</sub> Reactions

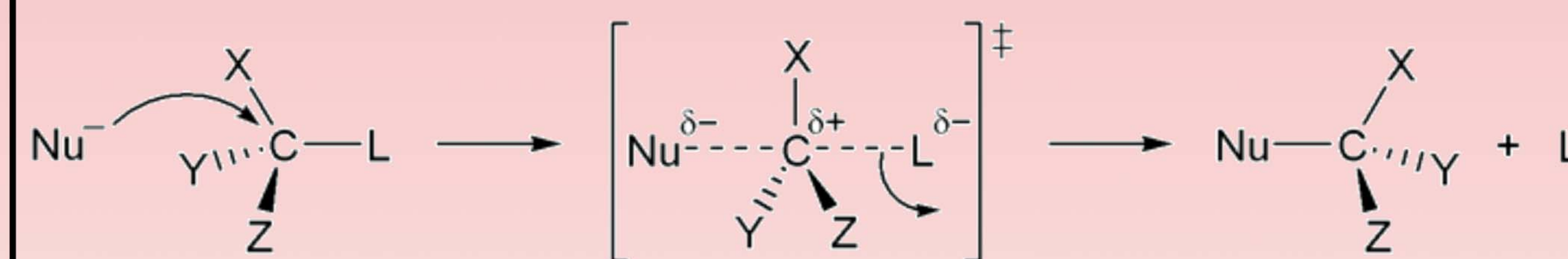


Figure 2. The mechanism of the SN<sub>2</sub> reaction

In the MeBr and MeI molecules the Carbon atom carries a partial positive charge and the the Br/I atom has a partial negative charge. When a negatively charged species, a nucleophile (Nu-), is present it attacks the positive Carbon and the bond between the Carbon and the Br/I atom is broken, releasing the Br- and I- ions into the atmosphere.

## Toxicity of MeBr and MeI

Glutathione is a natural antioxidant that protects DNA by preventing oxidation and is responsible for allowing proper protein pairings, ensuring that they function properly. When the molecule undergoes an SN<sub>2</sub> reaction with the pesticides, it produces a new molecule that leads to the production of methanethiol. This can cause serious damage to the central nervous system and if left to react with CH<sub>2</sub>OH then reduced to CHOH (formaldehyde), it can be detrimental at high levels in the body.

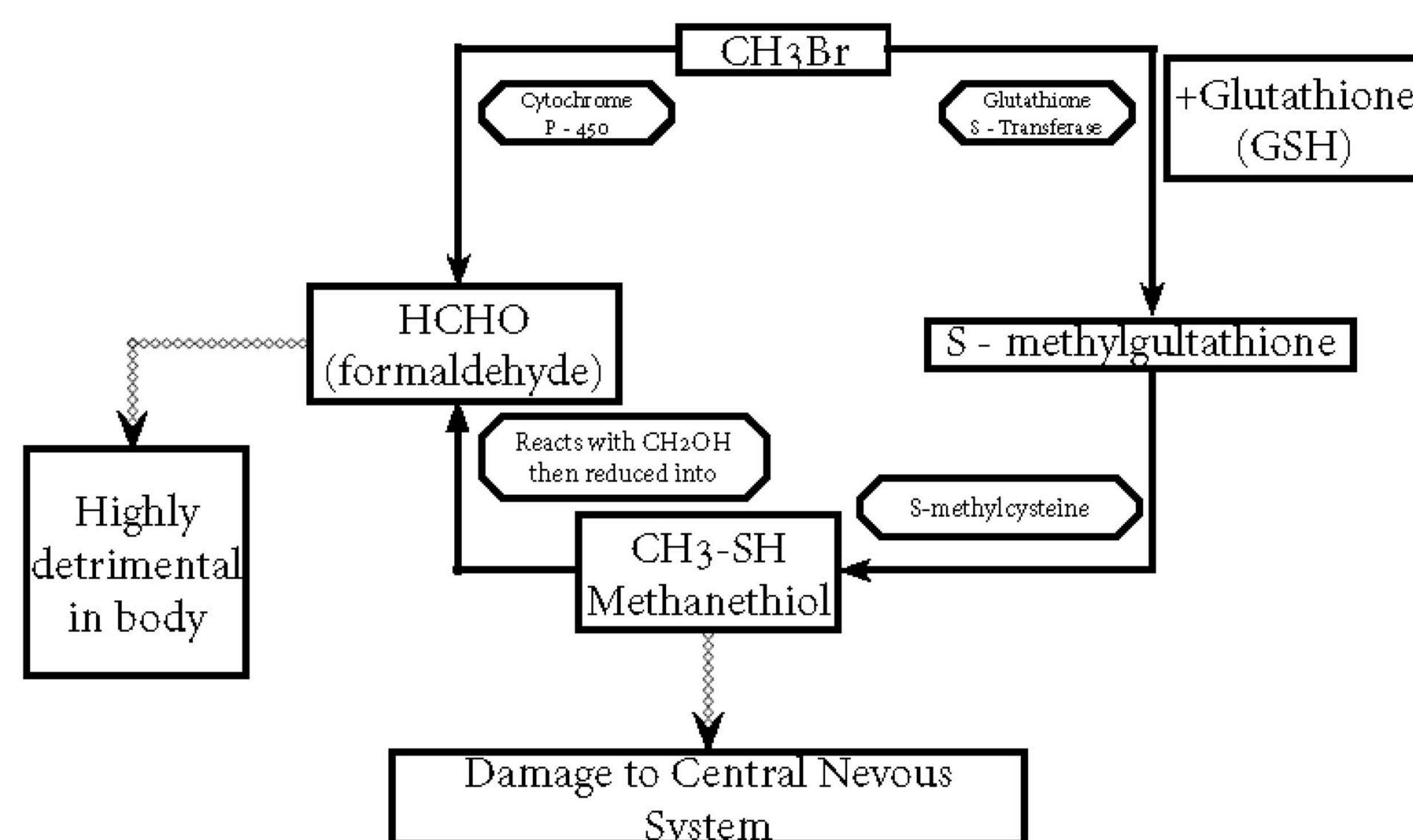


Figure 3. Toxicity of MeBr

## Methodology

- Analyzation of pesticide use history as well as further research on the harm to human subjects
- Formation of the case study with both the fictional story and relation to chemical mechanisms
- Presentation to students and the test of educational understanding on the mechanisms through surveys and quizzes
- After being exposed to the case study it is expected that the students will be able to perform the mechanisms on their own. They should be able to draw out and explain the mechanisms step-by-step.

## References

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