

NavMol 2.2s – A software for navigation and editing of molecular formulae for blinds and visually impaired users

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INTRODUCTION

The change in paradigm that occurred in 1994 as a result of the UNESCO Conference of Salamanca, summarized in the expression “Education for All”, [1] helped to drastically review existing concepts on the education of students with special requirements. The “Inclusive School” meant that society needs to develop methodologies to teach blind and visually impaired students so that they have the same educational opportunities as the general population.

Chemical knowledge, and in particular that related to organic chemistry, with its close proximity to the living cell, can open new horizons to the individual: it enables a deeper perception of the surrounding physical world and a better understanding of

phenomena that impact daily life.

Scientific knowledge is fundamental in the modern world, and excluding blind people from science would represent a terrible waste of human talent and diversity. Indeed a diverse scientific workforce is increasingly recognized as being essential to ensure competitiveness in the high-tech global market place. [2] Companies and organizations have long recognized the value of including individuals with different approaches, life experiences, and backgrounds in multidisciplinary research teams. Many research problems can be solved most effectively when approached from multiple perspectives, and scientists who have disabilities, such as blindness, bring unique points of view to those teams. [3]

RESULTS

The NavMol 2.2s program, a software that enables the navigation of molecular structures and chemical reactions by blind and visually impaired (BVI) users, is presented. The software enables BVI users to interpret and edit molecular structures by making use of common accessibility tools. NavMol 2.2s uses voice synthesizers and time clock polar type coordinates to communicate with the blind user and, at the same time, displays a conventional chemical sketch on the screen for sighted users.

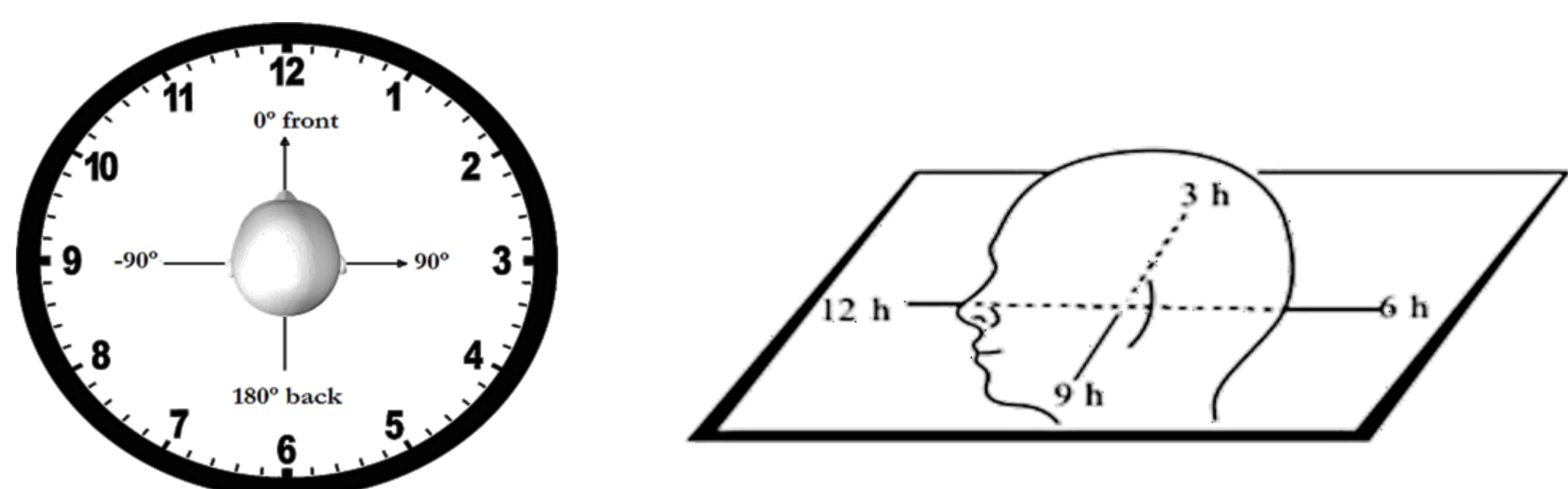


Figure 1. Representation of the head (facing 12 o'clock in the horizontal plane) and the direction of sound according to an analogue clock. From above (top) and from a side perspective (bottom).

Considering the user is selecting a certain atom in a molecule, then Navmol describes using audio all the neighbor atoms that have bonds with that atom.

Navmol also contains a graphical interface so that sighted users can better communicate with BVI users, helping with their integration in group learning as occurs in a classroom (Fig. 2).

The use of spatialized sound was introduced to help the blind users to grasp better the placement of the different substituents in the carbon framework of the formulae.

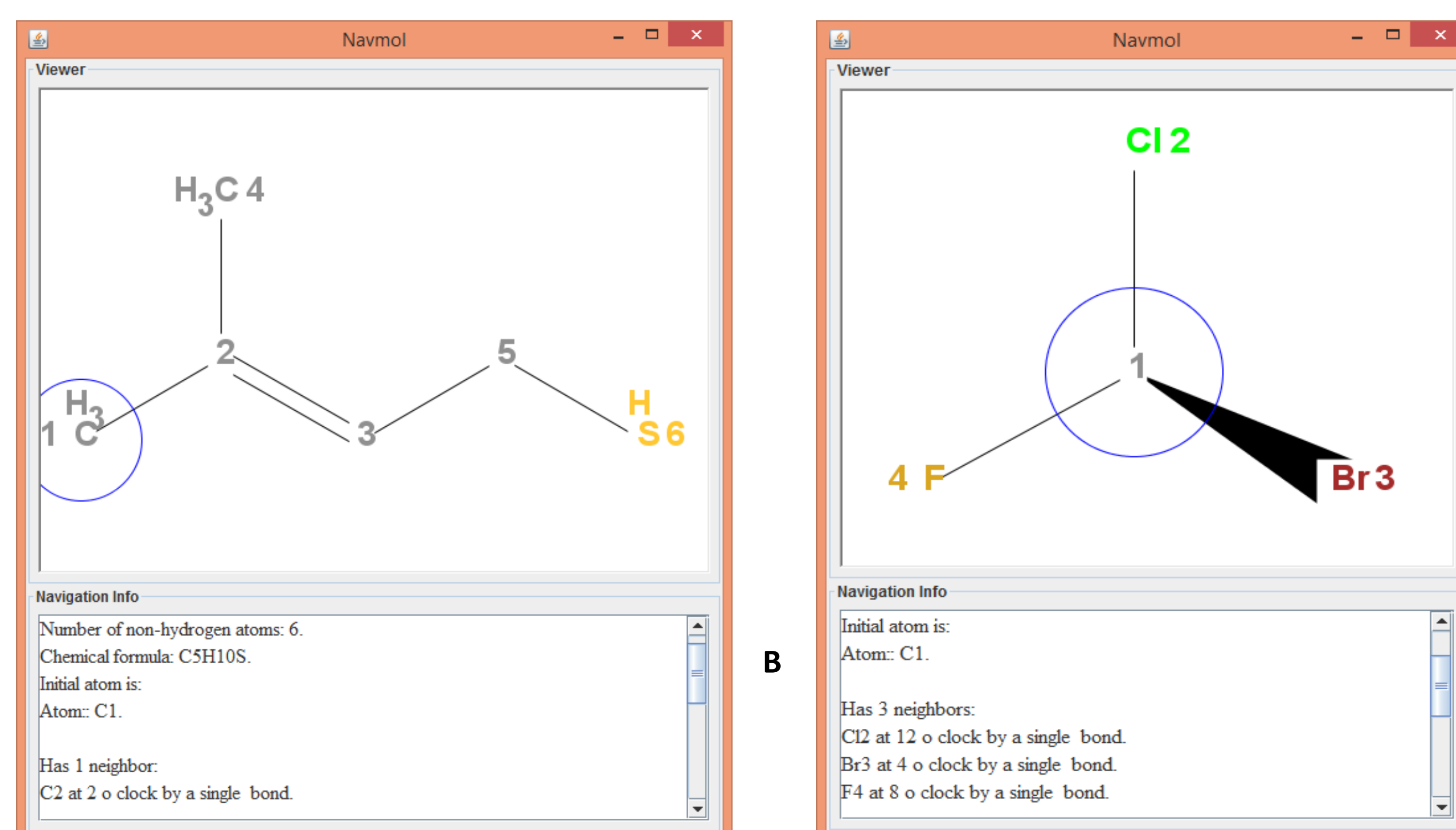


Figure 2. Example of the planar (A) and 3D tetrahedral (B) molecules.

CONCLUSIONS

Navmol is a pioneering software devised to solve the problem of reading and editing chemical formulae by BVI. The addition of *spatialized* sound to its audio version, considerably enriched the information perceived by the BVI users as far as the mental pictures conveyed by chemical formulae are concerned.

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References:

- [1] The Salamanca Statement and Framework for Action on Special Needs Education, UNESCO, 1994. http://www.unesco.org/education/pdf/SALAMA_E.PDF (accessed Oct. 2012).
- [2] Women, Minorities, and Persons with Disabilities in Science and Engineering, NSF-0327, Arlington, VA, USA, 2000.
- [3] D. L. Miner, R. Nieman, A. B. Swanson, M. Woods, K. Carpenter (Eds.), Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs, American Chemical Society Committee on Chemists with Disabilities, The American Chemical Society, Washington, DC.
- [4] <http://www.molinsight.net/> This link supports the BVI by providing computer manuals, download instructions for the software as well as texts related to chemistry. Other useful links to BVI are also listed.