Picturing the Chemical Relevance

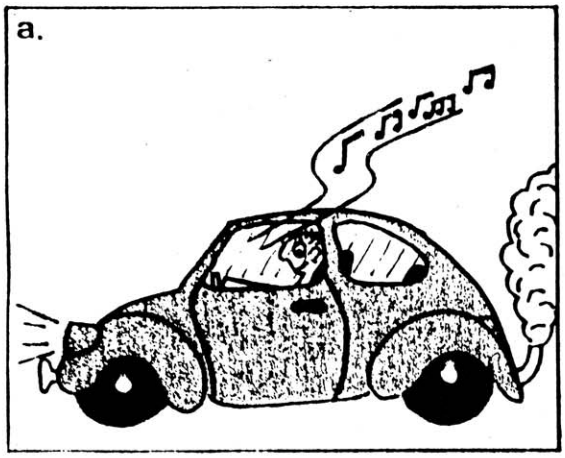
The Brazilian Chemistry in Action Group[1,2]
Universidade de São Paulo, Av. Prof. Lineu Prestes,748, CEP 05508, São Paulo, SP, Brazil

Chemistry is the fundamental science most directly related to everyday life. Thus, it is very important to talk about chemistry not only at school but also to the general public.

In the literature there are many articles describing, discussing, and explaining the relevance of chemistry.[3-5] In spite of that, students and nonscientists are not enlightened by lengthy texts, inevitably charged with technical jargon and elaborated formulas of difficult understanding. It is very hard to make people understand the relationship between chemistry and the facets of their everyday life. Frequently, the way used to show this relationship is by examples of how chemistry or chemical processes could improve life.

The current work is addressed to chemists involved in chemistry promulgation. It reports a different and original approach that shows how chemicals and chemistry already permeate our lives. The language and examples used are very basic, being directed mainly to high school students as well as to the "naive layperson". It is not our objective to present the most recent developments of chemistry but only to show its presence and importance. The idea was developed as a part of a "chemical show" being presented on a sporadic basis in several cities of our country (Brazil) and four times a week for three years at "Science Station", the first successful science museum in the city of São Paulo, sponsored by the National Research Council of Brazil.

An effective way to verify the importance of something is to show how its presence is missed. The best way to clarify this idea is by means of good images. For example, we could think about a very simple and common situation—a car on a highway. The figure shows a humorous sequence of scenes developed to exemplify the importance of chemistry. Probably, the car's driver in Figure a, is not aware of how near chemistry and chemicals are to him. We can illustrate this point making a "strip tease" of this scene. Instead of a stripper taking clothes away, we can take off "chemistry", i.e., any process or substance that was produced by chemical transformations. Therefore, we can look to the scene in part a of the figure and answer the question: What would happen to the car if chemical reactions ceased to occur?



The first consequence is that the car stops (Figure b). It stops because its kinetic energy is produced by the combustion in the motor. Combustion is a chemical reaction between the fuel (usually gasoline) and oxygen from the air. Additionally electrical power for the car's headlights, horn, radio, etc., comes from electrochemical reactions occurring at the battery.

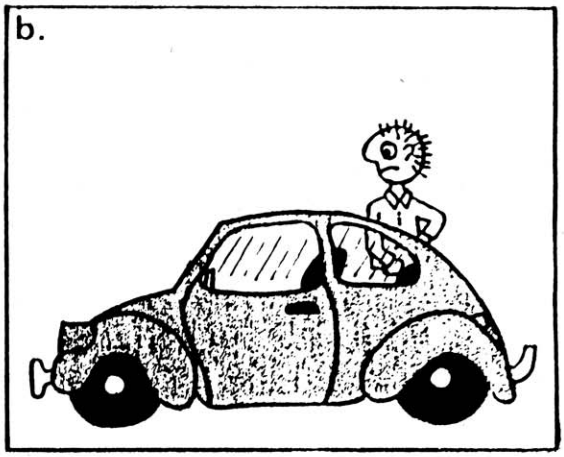
[1] The Brazilian Chemistry in Action Group has the following participants: J. A. Vanin and M. Regina Alcantar a (Coordinators); N. M. C. Aires; M. H. Altarugio; M. A. Autuori Leme; M. P. de Barros; A. G. Brolo; D. Daltin; O. Felippe Jr.; R. Frignani; A. N. Geraldes; C. M. Langer; M. S. Lessa; S. W. Locatelli; A. L. M. L. Mateus; A. S. Maia Jr.; M. F. P. de Oliveira; P. A. Porto; M. Ramanoski; S. F. Roque; A. A. de A. Sampaio; H. Y. Tsen; J. J. T. Wagner; E. Zanardi.

[2] Correspondence should be addressed to Grupo Quimica em Acão, a/c José Atilio Vanin, Instituto de Quimica, Universidade de São Paulo, Av. Prof. Lineu Prestes, 748, CEP 05508—São Paulo—SP, Brasil.

[3] Seymour, R. B. *J. Chem. Educ.* **1987,** *64,* 63-68.

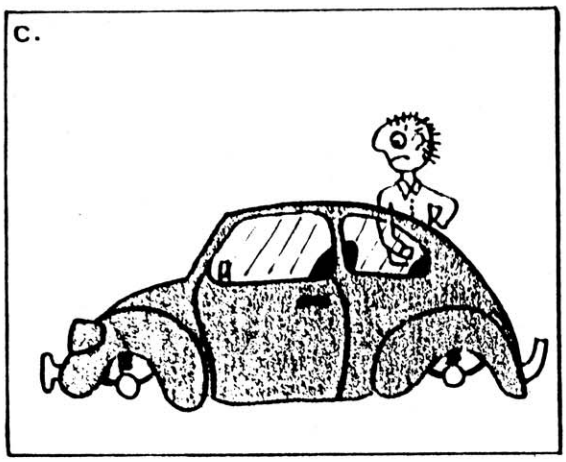
[4] Stine, R. W. *Chemistry for the Consumer,* Allyn and Bacon: Boston, 1978.

[5] Deanin, R. D. *J. Chem. Educ.* **1987,** *64,* 45-48.

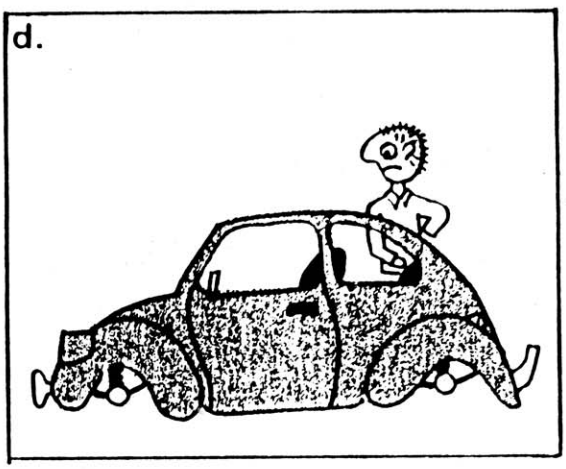


We can continue by asking: What would happen if the chemical reactions used by industries to prepare the car's different parts had ceased to occur?

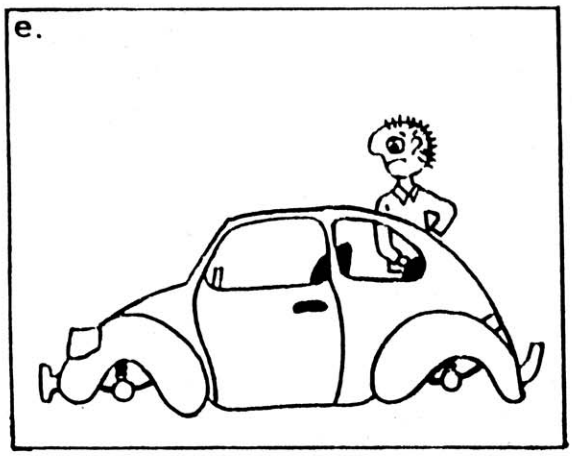
The car would not have its tires (Figure c). Most rubber used to produce tires is a synthetic polymer obtained from petroleum or natural gas. Even the natural polymer has to benefit from chemical transformation (like the vulcanization process) to be used. Without chemical reactions we would not have rubber in a usable form.



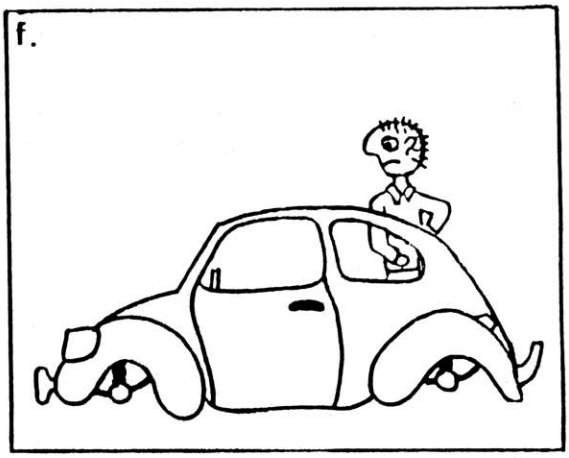
The car's glass parts are made by fusing sand (silica) with various metal oxides (depending on the desired properties). Colored glasses are produced by addition of different chemical species like metal ions. Consequently, without chemistry cars would not have glass (Figure d).



Some people like red cars, others prefer green ones. Could they choose the colors of their cars without chemistry? Of course not! Paints are made by different chemical reactions. Even natural pigments (like the white titanium oxide) are useful only after chemical processing. The production of paints involves very complex problems. To provide stable systems, it is necessary to use very different chemical substances like surfactants, solvents, and stabilizers. Figure e shows an uncolored car.



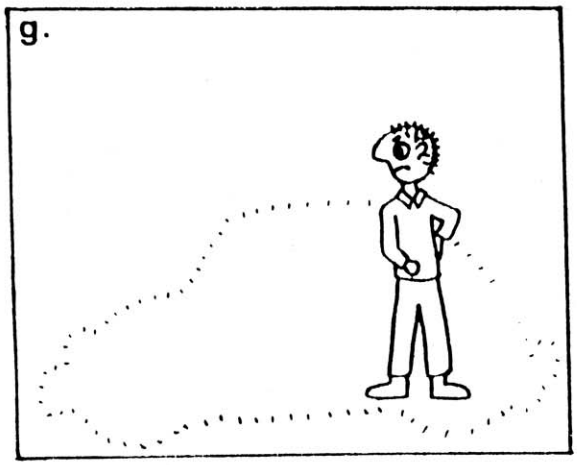
Could you drive a car without seats (Figure f)? Most foam used to make car seats is composed of polyurethane polymers. These substances are industrially produced by complex chemical reactions. The coatings of the seats are frequently polymeric materials, prepared through chemical processes. Sometimes, natural leather is used, but even in this case it must be tanned.

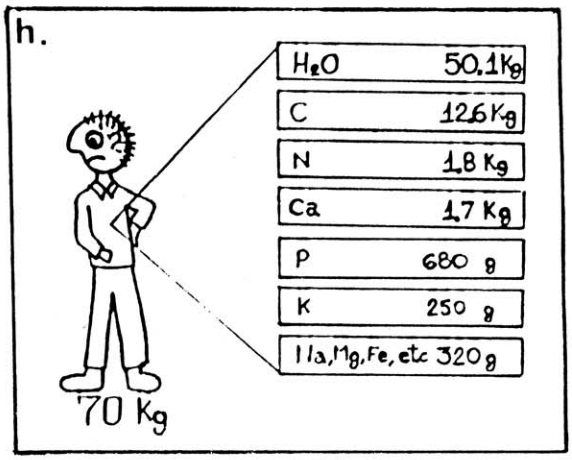


The metal used for the car's body results from several processes: mining, ore separation, reduction of the natural oxide to metal, and metallurgical processing. Chemical reactions are involved in all these steps. Without them it would be impossible to assemble the motor, the chassis, and the metallic body of the car. This means that without chemical processing the car would not exist (Figure g).

After the car disappears, the car's driver remains. Even the driver, as a human being, is the site of important biochemical transformations. His body is like a great laboratory, made from chemical substances composed by chemical elements, where several complex chemical reactions occur simultaneously. The rough composition of a human body is shown in Figure h.[6]

[6] Alyea, H. N.; Dutton, F. B. *Tested Demonstrations in Chemistry*, 6th ed.; Chem. Educ. Pub. Co.: Easton, PA, 1965.





The sequence of pictures in the figure was specially developed for overhead projectors. A slide projection technique with aid of the lap dissolve, a videotape, or an animated cartoon could be produced based on the story board here reported. Even a simple theater sketch could be devised to be played by students. So the series is suitable for any pictorial media at the teacher's disposal.

The discussion of quotidian situations is specially important when talking to nonscientists and students. The message to be passed has a sedimentary characteristic, i.e., it is promptly received but it is slowly understood and assimilated. The learning process is not efficient if the receiver does not identify him- or herself with the situation. Examples based on customary scenes enable each person to create analogues with his or her own regular habits, leading, after some time, to the clear comprehension of the chemical relevance.

The present work details only one scene of everyday life where we explore not the presence but the absence of chemistry and chemicals. The reported sequence corresponds to a simple scene, but the relevant presence of chemistry can also be shown in more complex situations. A family at home, someone in a kitchen, a patient in a hospital, the construction of a ship, or even the launching of a space shuttle could be explored. Remembering that humankind is the world's premier consumer of chemicals,[3] it is easy to imagine many other situations where the relevance of chemistry could be explored in the way here suggested. All of them could be used, especially if they explore the usual situations of public's life.