| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | $2NaOH(ac) + H_2SO_4(ac) \rightarrow Na_2SO_4(ac) + 2H_2O(l)$ | | | |
| 3 | | | | | |
| 4 | | | x | | |
| 5 | | | 0,2 | | |
| 6 | | | | | |
| 7 | | | NaOH | $H_2SO_4$ | $Na_2SO_4$ |
| 8 | | volumen (L) | **0,200** | **0,150** | **0,000** |
| 9 | | concentración (M) | **2,0** | **2,0** | **0,0** |
| 10 | | inicial (mol) | 0,40 | 0,30 | 0,00 |
| 11 | | cambio (mol) | (-2x) | (-x) | (+x) |
| 12 | | cambio (mol) | -0,40 | -0,20 | 0,20 |
| 13 | | final (mol) | 0,00 | 0,10 | 0,20 |
| 14 | | | ¡limitante! | exceso | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | 40 | | |

**Figura 7: Simulación de estequiometría con concentraciones. Las operaciones realizadas son: celda C5: =C18/200, celda C10: =C9*C8, celda D10: =D9*D8, celda E10: =E9*E8, celda C12: =-2*C5, celda D12: =-C5, celda E12: =C5, celda C13: =C10+C12, celda D13: =D10+D12, celda E13: =E10+E12, celda C14: =SI((C13)<=0;"¡limitante!";"exceso"), celda D14: =SI((D13)<=0;"¡limitante!";"exceso").**

## CONCLUSIONES

Se ha presentado una forma diferente de abordar y resolver problemas químicos a partir del empleo de la barra de desplazamiento en el contexto de la hoja de cálculo., cuyo resultado final es una simulación dinámica y versátil, de entorno visual agradable que permite formular y responder preguntas del tipo "¿qué pasa si…?".

La propuesta desarrollada hace hincapié en aspectos conceptuales de estequiometría por sobre la resolución rutinaria de ejercicios numéricos. Los estudiantes haciendo uso de las relaciones estequiométricas que se establecen entre todas las sustancias (reactivos y productos) construyen una simulación numérica que les permite hallar la composición del sistema a medida que avanza la reacción, partiendo de las condiciones iniciales.

En otro artículo (Raviolo, 2002b) se han mostrado los resultados de la experiencia didáctica realizada con hojas de cálculo en primer año de la universidad, resaltando sus ventajas con respecto a la enseñanza tradicional y el cambio positivo de actitudes hacia el aprendizaje de la química y hacia las TIC evidenciado por los alumnos.

La formulación del planteo Inicial, Cambio y Final es de gran relevancia conceptual, dado que ayuda a identificar la composición en distintos momentos de la reacción y a diferenciarla de la relación estequiométrica. El profesor puede orientar las preguntas de modo de verificar la presencia o superación de las dificultades o concepciones alternativas mencionadas en la introducción.

El archivo con las simulaciones desarrolladas en este artículo pueden ser solicitadas al autor por correo electrónico.

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# Explaining *trans* geometric isomerism through a board game with a focus on food and *trans* fat

# Explicación de *trans* isomería geométrica mediante el juego de mesa con el foco en alimentos y grasas trans

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***Abstract***

*The work created a board game with a focus on information about ¬foods and trans fats to connect the geometric isomerism taught in chemistry in a fun and educational way. The study was conducted with students at the city of Apucarana, Parana, Brazil. Initially, a lecture with a multimedia kit on the subject was presented, after it was shown and discussed some packets of biscuits originally from main market where trans fats were emphasized. Then groups of 4 people were formed to play the board game with cards. The explanation of the information "0% trans" is not zero, but up to 0.2 g of trans fat per portion was particularly important for students who showed in a biscuit brand where eating three units could get to have up to 30 g. The finding that eating three units accounted for 10% of the recommended total, the package containing 200g is 67% of the total recommended it was enough, in general, to alert the students, especially those who eat an entire package along the day. The game proved its importance increasing the debate and encouraging students to enhance learning. In addition, the project was able to explain, eye-catching advertising, teach and open the horizons of students.*

***Keywords*** *cis, trans, chemistry, teaching, fats*

***Resumen***

*El trabajo ha creado un juego de mesa con un enfoque en la información sobre los alimentos y las grasas trans para conectar la isomería geométrica enseñado química de una manera divertida y educativa. El estudio se realizó con estudiantes de la ciudad de Apucarana, Paraná, Brasil. Inicialmente, se presentó una ponencia con un kit multimedia sobre el tema, después de que se mostró y discutió algunos paquetes de galletas principal mercado de la región en la que se hizo hincapié en grasas trans, y formó grupos de 4 personas para el juego de mesa con cartas. La explicación de que la información "0% trans" no es cero, pero puede ser de hasta 0,2 g de grasas trans por porción fue particularmente importante para los estudiantes porque en un caso, una de las marcas de galletas rellenas, la porción (tres unidades) podrían ser de hasta 30 g de grasas trans. El hallazgo de que el consumo de tres unidades representaron el 10% del total recomendado, el paquete que contiene 200 g es de 67% del total recomendado fue suficiente para alertar a los estudiantes en general, especialmente a los que comen un paquete completo durante el día. El juego resultó ser importante para aumentar el debate y alentar a los estudiantes a mejorar el aprendizaje.*

***Palabras clave:*** *cis, trans, química, educación, grasas*

## INTRODUCTION

When teaching chemistry, sometimes it can be difficult to transmit the ideality of a topic, for example, the cis-*trans* geometry of molecules, both in relation to the practical application of its knowledge, and with regard to attracting or arousing attention of the students to this content.

According to ROGADO (2004), whose work considered the difficulties with the amount of a substance and its unit, the mole, in chemistry teaching. It is not sufficient simply to know the definition, but learners need knowledge of the context in which the concept arises and also the interactions with other concepts - their similarities and differences.

The understanding of the geometric isomerism requires the understanding of the stereo factors, arrangement of substituent groups in the space and nomenclature. The lack of mastery of these skills can lead to learning difficulties, especially if students cannot see an immediate application for this concept (LISBOA, 2010).

In concordance with the International Union of Pure and Applied Chemistry (IUPAC, 2006), cis-*trans* isomerism occurs in compounds which might differ in the positions of atoms (or groups) relative to a reference plane – usually the plane defined by a 'double bond'. In the cis-isomer, the atoms are on the same side, in the *trans*-isomer, they are on opposite sides, as shown below:


These differences between cis and *trans* are very important in respect to *trans* fats (TFA), since the high intake of these correlate with increasing levels of cholesterol. It is noteworthy that the word 'cholesterol' has great influence on the population, probably because it is associated with health problems, as an increase in the level of blood cholesterol is considered one of the main factors leading to cardiovascular diseases (STROHER et al., 2012; MENSINK & KATAN, 1990; MARTIN *et al*., 2007).

Cardiovascular diseases are the leading cause of death and disability worldwide and they are correlated to the cholesterol excess. In addiction, some metabolic and epidemiological studies point to increased cardiovascular diseases due to the intake of TFA and saturated fatty acids (ASCHERIO *et al*., 1999, MOZAFFARIAN *et al*., 2004; EBERSON *et al*., 2003; STROHER *et al*. 2012).

In order to minimize the intake of *trans* fats, the World Health Organization (WHO) and the United Nations Food and Agriculture Organization (FAO) established that the recommended intake of TFA is less than 1% of total fat. Each gram of fat equals nine k-calories, so an adult who consumes 2,000 k-calories per day should not exceed 2g trans fats (WHO/FAO, 2003) – even if all energy is derived from fat.

According to Brazilian National Health Surveillance Agency (ANVISA), the foods used in their manufacture hydrogenated vegetable fat, margarine or fats from ruminant animals contain amounts of *trans* fatty acids. These products when analyzed are classified as *trans* fat-free (0g *trans*) when show values equal to or less than 0.2 g per serving of food and 0 is inserted into the nutrition labels (BRASIL, 2005).

In order to combine the learning of *cis-trans* isomerism as a subject of chemistry with the care of nutrition and health, a lecture and a board game with cards were developed, so the student could have a practical view of this content.

## METHODS

The study was conducted with students of 16-18 years enrolled in the three years of secondary education in public schools at the city of Apucarana, Paraná State, Brazil. Initially, we presented a lecture with a multimedia kit on the subject, showed a few packages of the main biscuits marketed in the region, and formed groups of 4 students for the board game with cards. The game (Figure 1 and 2) consists of a board (45x25cm), 22 cards and a dice. The board was numbered in ascending order; in the middle was placed the word *trans*, twice. The rules of the game were: roll the dice and move the number of spaces, read aloud the information of corresponding card, follow the recommendations of the card (the player moves forwards or backwards a given a number of spaces) and if the player stops for the second time at the word *trans*, he/she had to return to the start.

It is noteworthy that the games and lectures were in the presence of the high school teacher and that the material was donated to the school.

## RESULTS AND DISCUSSION

The work was developed with students who had few or no classes using a multimedia kit, which held a fascination and facilitated the transmission of knowledge. Both teachers and students, noted the importance of the visual (exposed by the multimedia) work on the issue, because the imagination does not always follow the knowledge that the teacher wants to transmit.

The fact of working with biscuits sold in the region, a common food, present in 98% of Brazilian houses (GUTKOSKI, 2002),

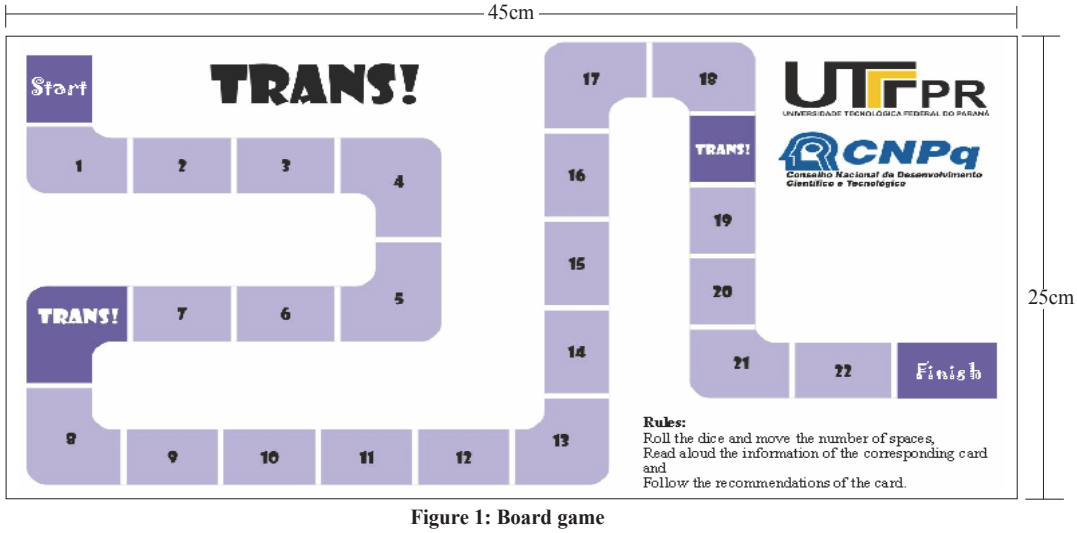


**Figure 1: Board game**

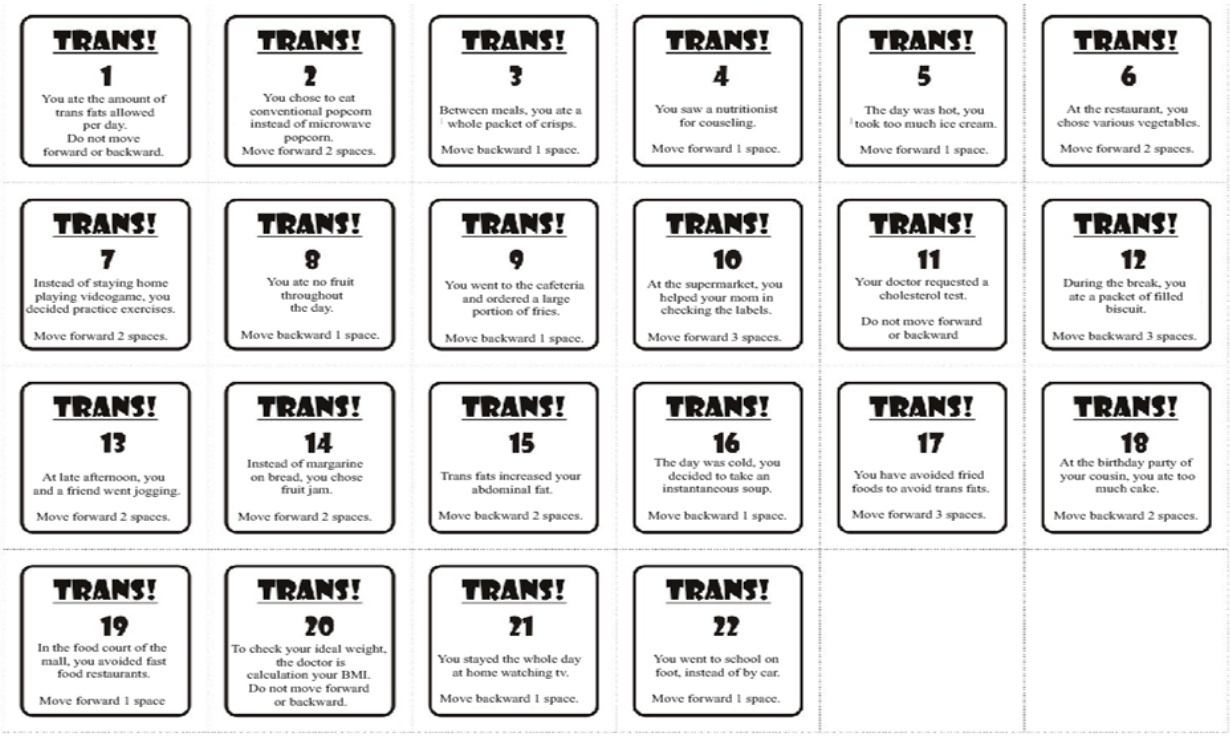


**Figure 2: cards game**

facilitated the arousal of awareness of the students to the topic. Also, it is worth remembering that the study was conducted with teenagers who start their concerns with the body (beauty and health) and the best training to the public are leading the nutritional improvements on the Brazilian biscuits.

The explanation of the information "0% trans" is not zero, but up to 0.2 g of trans fat per portion was particularly important for students who showed in a biscuit brand eating three units could provide up to 30 g. of fat. The finding that eating three units accounted for 10% of the recommended total, the package containing 200g is 67% of the total recommended it was enough, in general, to alert the students, especially those who eat an entire package along the day (BRASIL, 2005; WHO/FAO, 2003).

Besides that, STROHER *et al*. (2012) analyzed biscuits marketed in Brazil, savory, buttery, wafers and filled, and observed a decrease in the amount of *trans* fats from 2002 to 2012, but this decline came with the addition of saturated fats in the formulations, correlating with high cholesterol levels in the population, which can lead to disability or death (MARTIN *et al*., 2005; EBERSON *et al*., 2003).

Finally, the application of the board game with cards that brought 22 pieces of information about *trans* fats completed this work. A feature of this game was that the positive actions on the board resulted in going forward spaces while the opposite, in going backward. This simple fact allowed the students to really play the game competitively, as each end (one winner) caused the celebration of the players.

As a result, we noted that this work presents a clearer visual explanations (with the help of multimedia kits) even for lectures, combined with biscuits (everyday food) and the possibility of interaction between learners during the game was an initiative that contributed positively to attract their interest for learning geometric isomerism and chemistry.

## CONCLUSIONS

The presentation of geometric isomerism with multimedia kit is a differential in schools where the project was developed together with the game and biscuits with a focus on *trans* fats, and represented a valid and effective alternative to explain and make students interested in the various topics of chemistry. The game proved to be important to increase the discussion and encourage students to enlargement learning. In addition, the project was able to explain, hold the attention, teach and open the horizons of these students.

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