[SATLC- INITIATIVE]
USES OF SATL & MULTIPLE INTELLIGENCES [MI] FOR SECONDARY AND TERTIARY LEVELS
PART-I: BENZENE STRUCTURE ACTIVITY[1]

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ABSTRACT

This paper focuses on the uses of Systemic Approach to Teaching and learning [SATL] and Multiple Intelligences [MI] in Chemistry. In this work we integrated both SATL and MI in teaching and learning Chemistry in secondary and tertiary levels. This activity was designed by making use of musical-rhythmic, bodily-kinesthetic, interpersonal intelligences to enhance logical-mathematical, visual- spatial intelligences in teaching and learning Chemistry. By implementation of benzene structure activity model we expected from our students to go in a deep understanding of benzene structure and its chemical bonding, create attitudes towards working in a team and gain the ability to plan and implement efficient and effective outdoor systemic activity models in Chemistry. So, we introduce this activity as an applicable outdoor model which displays innovations in teaching and learning and demonstrates one of the methods of surpassing the traditional indoor methods. It could be extended to other topics of organic chemistry or other branches of chemistry. *[AJCE, 3(1), January 2013]*

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INTRODUCTION

It is well know that Chemistry is one of the most difficult and conceptually hard subjects in the school and university curricula. Many factors contribute to the complex nature of chemistry subject and much research work has been done in attempting to make conceptual chemistry easy to understand and more accessible for students (1). Much of the chemistry contents, at the secondary and tertiary levels, taught and assessed in terms of isolated facts and concepts without emphasizing conceptual understanding (2, 3). In the traditional linear way of teaching students are taught and assessed in many pieces of knowledge without any emphasis on connecting this knowledge into a functional framework.

Howard Gardner initially formulated a list of eight forms of intelligences (verbal-linguistic, logical-mathematical, visual-spatial, musical-rhythmic, bodily-kinesthetic, inter-personal, intra-personal, and naturalistic) (4, 5) or distinct areas of mental activities or skills, which are anatomically separate and can operate independently or in concert. Every individual is born possessing all the intelligences in varying degrees. These intelligences are dynamic in every student and can be strengthened or ignored and weakened. If it is strengthened in our chemistry students they will go in a deep learning of chemistry concepts.

Howard Gardner (6) suggests that the possibility of some students might have failed in certain school subjects such as chemistry or fined the subject difficult because of a mismatch between their intelligences profile and the methodology used to teach the concepts of this subject to them. For example, a student high in bodily-kinesthetic and musical-rhythmic intelligences and low in verbal-linguistic and logical-mathematical intelligences could find it difficult to understand the topic of particle kinetic theory if the teacher presents this topic by using the didactic traditional methods only. Kornhaber (7) stated that Gardner theory validates educators' everyday experience, and provides them with a conceptual framework for organizing and reflecting on curriculum assessment and pedagogical practices which make chemistry concepts more easily assessable. In turn, this reflection has led many educators to develop new approaches that might better meet the needs of a wide range of learners in their classrooms and make chemistry subject easy to learn.

Systemic approach meets the needs of both students and their teachers (8). Fahmy and Lagowski initially formulated systemic approach as one of the modern approaches that meets the student needs. Experimentation of SATL proved its effectiveness in both teaching and learning. SATL technique is a better instrument for making the teacher's job easier, as it enhances their communication skills (9-11). Nazir and Naqvi (12) stated that SATLC is a worldwide derives towards concept building of young generation through this novel mode of teaching and learning.

It was also stated (13) that, epistemologically, SATL can be considered as a hybrid approach that combines and uses features and ideas from systemics and constructivism adjusted in concept mapping procedures, and they also add that the originators of the SATL recognize the basic goal of this approach as "the achievement of meaningful learning by students" and suggest that this goal can be attained through the development of systems thinking, in a context of constructivist and systemic-oriented learning tasks (SATL techniques) (8,9).

Application of systemic approach to teaching and learning Linguistics and Math for the first three grades in the primary schools, proved the effectiveness in growing the skills for reading and writing and increases students' learning achievements. This encourage us to integrate both SATL& MI in teaching and learning Arabic, English Languages and Math in the first three grades of the primary schools (primary level). This was done by designing systemic outdoor activities (14). It was experimented successfully in some primary schools in Egyptian

Governorates (Cairo, Alexandria, Quina). The obtained results from this study showed that learning was effective on increasing students' learning outcomes.

In continuation of this work we integrated again both SATL and MI in teaching and learning Chemistry in secondary and tertiary levels. It is known that Chemistry represents one of the most difficult subjects because of a big number of abstract concepts and theories in its curriculum presented in a linear way of teaching. The topic covered in this model is the systemic study of the molecular structure of benzene correlated to covalent bonding, σ and π bonding, molecular shape and some electronic principles.

In this model all students exposed to a variety of experiences which stimulate the different intelligences in them and allow them to create rich environment for both teaching/learning. The staff members should design the presentation of the material in a way that engages most of the intelligences. The engagement of intelligences can take place at the end stage of the secondary level and the first year general chemistry of tertiary level.

The objectives of the present study are manifold and presented as below:

1. To use bodily-kinesthetic and musical-rhythmic**,** and interpersonal intelligences to enhance logical-mathematical, visual-spatial intelligences in learning Chemistry.
2. To enhance the quality of learning of molecular structure of benzene by presenting both Kekule structures and the resonance structures.
3. To change teaching/learning strategy of chemistry from a static mode inside the class room (indoor) to an active dynamic mode (outdoor).
4. To build systemic relation between *σ and π C-C* bond orbitals and the molecular structure of benzene.
5. To perform subject materials taught in lectures.

6. To build up communication skills.
7. To create better environment for teaching and learning chemistry.
8. To promote understanding of the systemic relation between intelligences.
9. To create attitudes towards working in a team.
10. To enhance student's appreciation towards chemistry subject.
11. To assess the systemic understanding of the model materials.

REQUIRMENTS FOR BUILDING SATL/MI ACTIVITY FOR BENZENE STRUCTURE

A. We ask our students to do the following jobs inside the classroom under supervision of Chemistry staff member:

1. Draw the two Kekule structures of benzene and its resonance structures.
2. Identify the chemical bonding in Kekule structure of benzene as *6-C-C σ* bonds, *6-C-H σ* bonds and *3-C-C π* bonds.
3. Identify the chemical bonding in resonance hybrid structure of benzene as *6-C-C σ* bonds, *6-C-H σ* bonds and *6-C-C partial π* bonds
4. Identify that each bond represents bond orbital contains two electrons.
5. Identify that benzene C-skeleton as a regular hexagon with equal C-C bond distances.
6. Draw the carbon symbol [C] and hydrogen symbol [H] on a piece of hard paper.

B. The teacher of Sports draws the regular hexagon of benzene [C-skeleton] in the middle of the playing area or the Gymnasium of the school or faculty.

METHODOLOGY

Implementation of bodily-kinesthetic, musical-rhythmic and inter-personal beside logical-mathematical, visual-spatial, intelligences and systemic approach in designing benzene structure activity

This activity was designed and prepared on the basis of cooperation between Chemistry, Sports, and Music staff members inside the classroom and then performed on the playing area or gymnasium hall of the school or faculty. This means that staff members should design the presentation of the activity material in a systemic way that engages bodily-kinesthetic, musical-rhythmic and inter-personal beside logical-mathematical**,** intelligences as shown in the following systemic diagram.

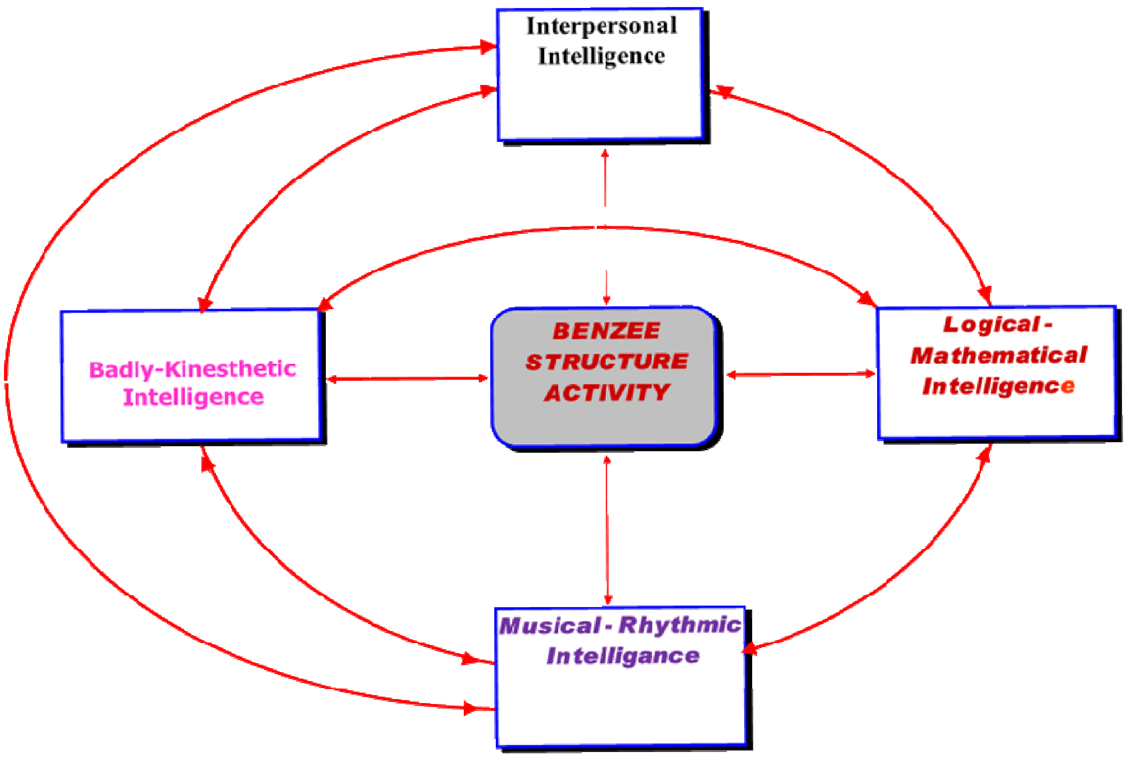

Figure 1: Systemic Diagram (SD)

The above SD (Figure 1) shows the systemic relations between intelligences engaged in the benzene structure activity. The above mentioned intelligences could be used by students in harmony. Under this learning strategy the concept could have been better grasped and remembered.

Scenario

All the class students will participate actively in the preparation of the materials used (indoor) and in the performance (outdoor).

First (Indoor) Chemistry staff member asks the students to write the following on pieces of white hard papers or small flags:

1. [6-C] and [6 - H] letters
2. 6-e letters represent electrons
3. The following names and concepts **BENZENE, KEKULE-1, KEKULE-2, RESONANCE HYBRIDE**

Second (Indoor) Chemistry staff member asks the students to do the following:

1. One student raises **RESONANCE HYBRID** paper.
2. Six students raise six ***Carbon [C]*** papers.
3. Six students raise six ***Hydrogen [H]*** papers.
4. Six students raise **six *Electron [e]*** papers.

Third (Outdoor) Afterwards Chemistry staff member [CSM] *in cooperation with Sport staff member [SSM] takes all the class students to the playing area or gymnasium hall of the school or faculty and then:*

1. Sport SM asks all the class students to stand around the playing area.
2. Systemic [Fig.2] was constructed at the middle of the playing area by the aid of the sport SM.
3. Chemistry SM asks the **BENZENE** labeled student to stand at the center of the regular hexagon (Fig.2).

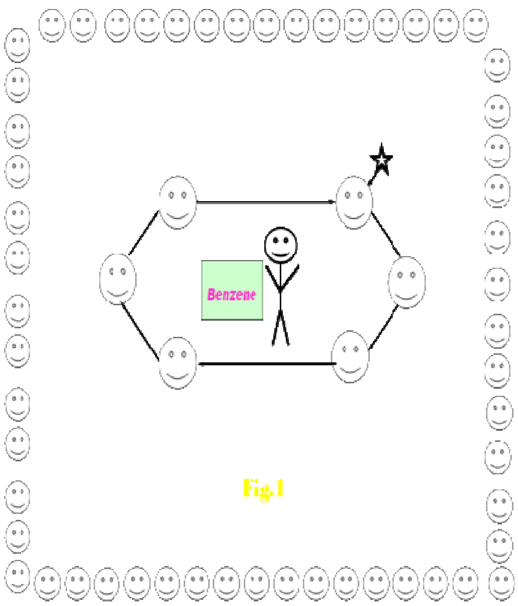

Figure 2: Regular Hexagon

<u>Fourth (Outdoor)</u> Then Chemistry SM asks the students afterwards to do the following;

1. Six Carbon atom [**C**] labeled students to stand at the corners of benzene systemic (Fig.2). Each carbon labeled student is joined by hands to the two adjacent identical Carbon labeled students instead of one to form two identical sigma bonds.
2. Six Hydrogen **[H]** labeled students to stand beside the 6- carbon labeled students at the six corners of benzene systemic [Fig.3].

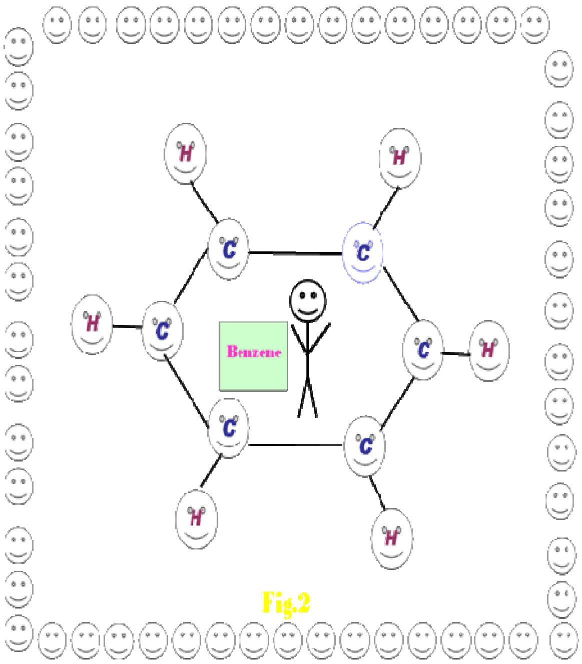

Figure 3: The Benzene Systemic

3. The above performances takes place with the help of sport and music SM
4. At this stage of performance, chemistry SM asks students around the playing area about:
   a. The number of sigma **C-C & C-H** bonds in the performed model by12 students.
      - The students reply that there are **6-C-C** Sigma bonds & **6 C-H** sigma bonds
   b. The reason for the regular hexagon of the **C-skeleton** of benzene.
      - The students reply that is due to the fact that all **C-C** sigma bonds are identical and then the bond lengths are the same.

Fifth (Outdoor) Chemistry SM asks the students afterwards to do the following:

1. Six electrons [e] labeled students to stand at three sides of benzene systemic (two on each alternating sides and connected by hands). This presentation shows alternating double and single bonds between carbon atoms of benzene.

2. Kekule-1 labeled student to stand beside the benzene systemic [Fig.4].

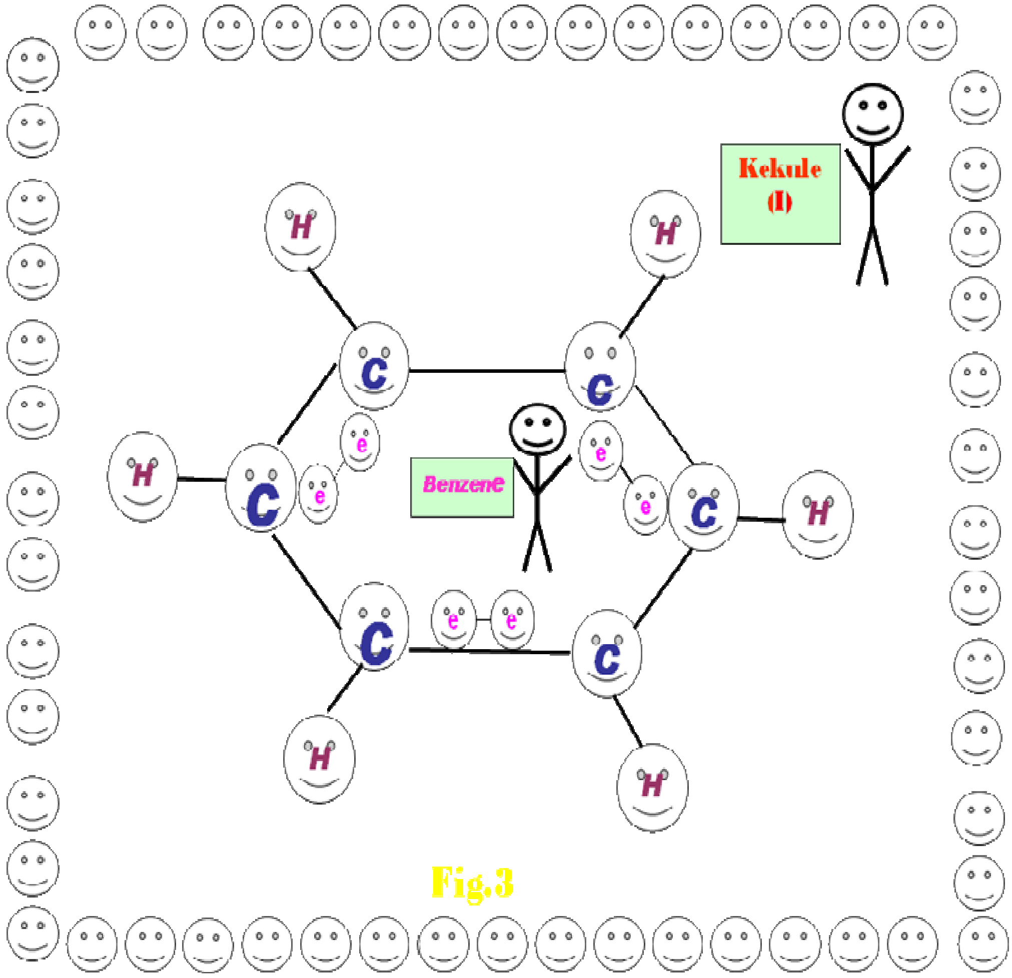

Figure 4: The Benzene Systemic with Kekule-1

3. The above performance movements accompanied by music and takes place with the help of sports and music SM.

4. At this stage of performance, chemistry SM asks students around the playing area about the number of **π bonds** performed by 6 students in the performed model.

– The students reply that there are **3 π bonds** alternating with single bonds.

<u>Sixth (Outdoor)</u> Then chemistry SM asks the students afterwards to do following:

1. Six electrons **[e]** labeled students to move and stand at the other alternating sides of the benzene systemic (two on each alternating side and connected by hands).
2. The Kekule-1 labeled student to change the benzene structure by raising Kekule-2 instead of Kekule-1 [Fig.5].

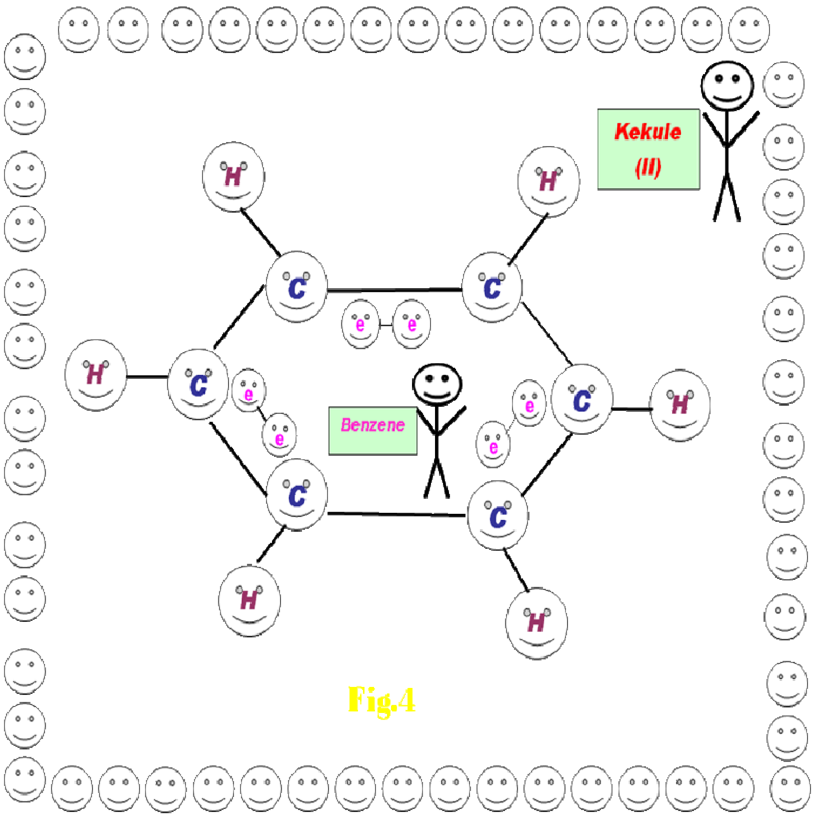

Figure 5: The Benzene Systemic with Kekule-2

4. At this stage of performance, chemistry SM asks students around the playing area about the difference between Kekule-1 & Kekule-2 in the performed model.
   - The students reply that the difference is in the arrangement of the **3 π** bonds in the regular hexagon of benzene.

<u>Seventh (Outdoor)</u> The Chemistry SM asks the students afterwards to do the following:

1. Kekule-2 labeled student to withdraw to the corner of the playing area.
2. Six electrons **[e]** labeled students to stand at all the sides of benzene systemic (one on each side and connected by hands) and move in a circular motion inside the benzene systemic.
3. Resonance hybrid labeled student to stand beside the benzene systemic diagram [Fig.6].
4. The above performances take place with the help of sport and music SM.

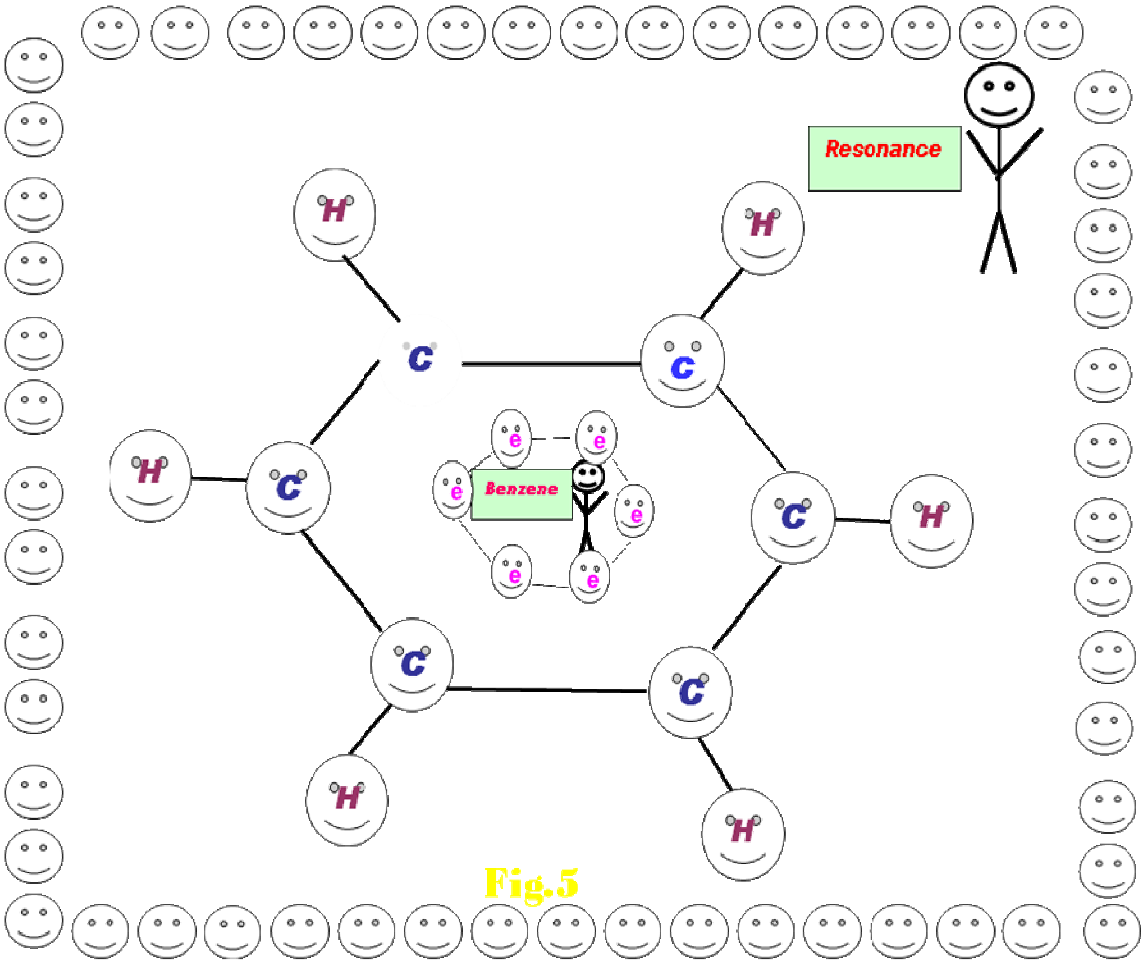

Figure 6: The Benzene Systemic with Resonance

5. At this stage of performance, chemistry SM asks students around the playing area about the difference between Kekule-2 & Kekule-1 structures & resonance hybrid structure in the performed model.
   - The students reply that they differ in the arrangement of the **3 π** bonds: In Kekule-1 and Kekule-2 the **3 π bonds** are localized on the three sides of the benzene hexagon; however, in the resonance hybrid structure they are delocalized on all **C-C** bonds of the regular hexagon structure of benzene.

The systemic study of the benzene structure activity was presented by the systemic uses of the musical-rhythmic, bodily-kinesthetic, inter-personal, to enhance logical-mathematical and visual-spatial intelligences in teaching and learning chemistry.

Eighth (Finally) The Chemistry SM announces the end of Benzene Structure performance, and asks the students of the class to withdraw from the playing area to the classroom by the aid of sports SM.

APPLICATIONS OF THE ACTIVITY MODEL

This activity model could be used as an applicable model for benzene structure. The idea could be extended to cover other areas like electrophilic substitution reactions of benzene, stereochemistry, reaction mechanisms and types of chemical bonding.

By implementation of Benzene structure activity Model we expected from our students the following:

1. Go into a deep understanding of α and **π** bond orbitals, localized and delocalized **π** molecular orbitals and their role in the benzene structure and reactivity.

2. Gain interpersonal skills, relating to the ability to cooperate with others and to work in a team.
3. Create better environment for both quality and quantity of learning.
4. Fostering the ability to explain scientifically and demonstrate knowledge and understanding of essential facts, concepts, and theories related to the benzene structure and reactivity.

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