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## **USE OF GRAPHIC ORGANIZERS IN SECONDARY CHEMISTRY LESSONS**

Canan Nakiboglu  
Balıkesir Üniversitesi

**Abstract:** Graphic organizers are the visual representations that show the organization or structure of concepts as well as relationships between concepts. The effective use of graphic organizers may be a magnificent strategy to help students connect ideas and they can be added to instructional materials to communicate the logical structure of the instructional material. This study aims to show how graphic organizer use within teaching duration by presenting different types of graphic organizers and to provide an overview of the benefits of using the graphic organizers for teaching and learning of secondary chemistry lessons. For this purpose, the graphic organizers which are examples of different types of graphic organizers have been prepared for selected topics from 9th to 12th grade in this study. The graphic organizers (such as semantic future analysis, a flow diagram, comparison contrast matrix, spider web, fishbone, positive and negative-interest diagram, word mapping, persuade map, cause-effect diagram, concept map) have been presented and discussed how they use in the chemistry lessons in this study.

**Keywords:** Graphic organizers, chemistry lessons.

### **Introduction**

Studies have shown that secondary school students find chemistry topics and concepts difficult. One of the reasons of the difficulties can be that the concepts of chemistry are too abstract for these level students. Additionally, the chemistry includes explanations of invisible interactions between invisible entities. It also includes declarative knowledge, procedural knowledge, relational knowledge and problem solving which can each of them contain low or high levels of cognitive complexity. Students need to construct the relationships between facts, concepts, and or ideas within a learning task.

Graphic organizers are the visual representations that show the organization or structure of concepts as well as relationships between concepts. The effective use of graphic organizers may be a magnificent strategy to help students connect ideas and they can be added to instructional materials to communicate the logical structure of the instructional material. Graphic organizers can help students organize their knowledge and encourage them to become actively engaged in the discussion of a topic and its concepts. Therefore, use of graphic organizer can assist make expository texts which are difficult to understand because of problematic nature of the topics more understandable for the students (Gil-Garcia and Joaquin, 2003). Besides, since graphic organizers are flexible, they can be used before, during, and after instruction.

The cognitive approach seeks to understand how incoming information is processed and structured into memory (Weinstein & Mayer, 1986, in Dye, 2000). Wills and Ellis (2008) indicate that several cognitive theories, in particular, lend support to the use of graphic organizers in helping students process and retain information. They also express that schema theory, dual coding theory, and cognitive load theory provides the basis for explaining the characteristics of graphic organizers that support the learning process. Dye (2000) have also shown the relationship between graphic organizers and how information is processed through the short-term memory and the long-term memory.

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\*Corresponding author: Canan Nakiboglu - E-mail: canan@balikesir.edu.tr

## The Aim of the Study

It is important to employ graphic organizers in the high school chemistry lessons to help students better understand abstract chemistry concepts and to construct the concepts each other in a meaningful way in their cognitive structure. This study aims to show how graphic organizer can use within secondary chemistry teaching duration by presenting different types of graphic organizer examples and to provide an overview of the benefits of using the graphic organizers for teaching and learning of secondary chemistry lessons.

## Methods

### The preparation of the graphic organizers, their types and selection of the chemistry topics

When the literature about graphic organizers is examined, it is seen that there are a variety of shapes and forms of graphic organizers. The shape of the graphic organizer varies depending on the content of the instruction and its purpose. In this study ten graphic organizers as semantic future analysis, flow diagram, comparison contrast matrix, spider web, fishbone, positive and negative-interest diagram, word mapping, persuade map, cause-effect diagram, and concept map have been selected and prepared for so many topics placed in 9<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> grade chemistry courses.

While preparing the graphic organizer, some points have been taken into consideration in the selection of chemistry subjects. First of all, it has been paid attention that it is the most suitable graphic organizer for the selected chemistry topic. Later, chemistry topics and concepts that abstract chemistry concepts or subjects students are difficult to understand are chosen. The graphic organizers and their subjects are: word map about electron, semantic future analysis about elements of periodic table, flow diagram about type of elements, comparison contrast matrix about nuclear energy, spider map about intermolecular forces, fishbone about galvanic cell, positive and negative-interest diagram about acids, persuade map about states of matter, cause-effect diagram about environmental pollution, and concept map about atom. Only three examples from aforementioned graphic organizers have been presented in this study.

## Results And Findings

Some of the graphic organizers are explained below briefly and several examples are presented.

### Word Map/Concept Definition Map

Students use critical thinking skills and prior knowledge to make connections among new words in this word map graphic organizer. Word maps are especially useful for abstract concepts and academic words. They help the student build upon prior knowledge and visually represent new information. An example word map concerning electron was presented in Figure 1.

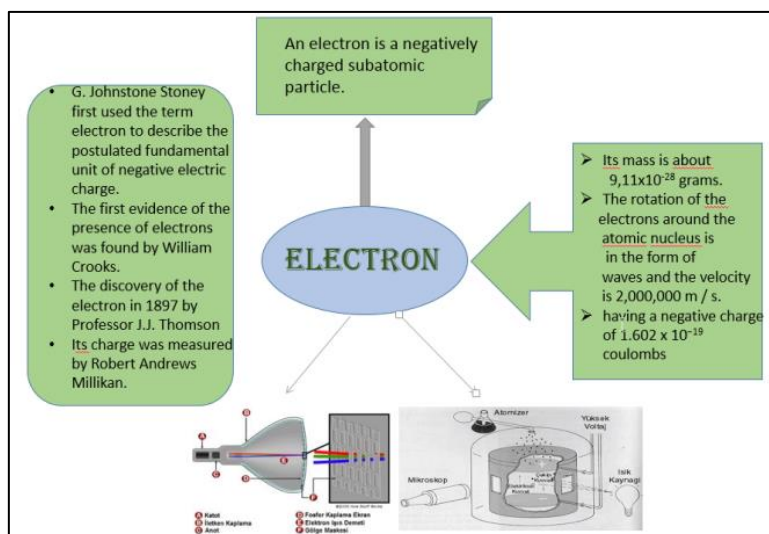


Figure 1. A word map graphic organizer

### Semantic Feature Analysis Table

The semantic feature analysis table uses a grid to help kids explore how sets of things are related to one another. By completing and analyzing the grid, students are able to see connections, make predictions and master important concepts. This strategy enhances comprehension and vocabulary skills. Semantic feature analysis can be used, when the task is comparing characteristics among a group of items (Graphic Organizers, 2010). In this study, a semantic feature analysis which has been prepared for the topic “elements of periodic table” placed in 9<sup>th</sup> and 11<sup>th</sup> grade chemistry curriculum is shown in Figure 2.

### Flow Diagram

Use a flow diagram to show the progression of ideas, thoughts, or steps in a subject or an experiment. In flow diagrams, logic steps that need to be followed for the solution of any problem are expressed visually as symbols or symbols. An example flow diagram has been prepared for Periodic Table topic and shown in Figure 3.

Features	Alkali Metals	Alkaline Earth Metals	Transition Metals	Lanthanides	Actinides	Metal	Nonmetal	Noble Gas
Ca		+						
Ni			+					
Xe								+
Th					+			
Ce				+				
Se							+	
Bi						+		
Fr	+							
Fe			+					
Ga						+		
P							+	
Li	+							
Cr			+					

Figure 2. A semantic feature analysis table

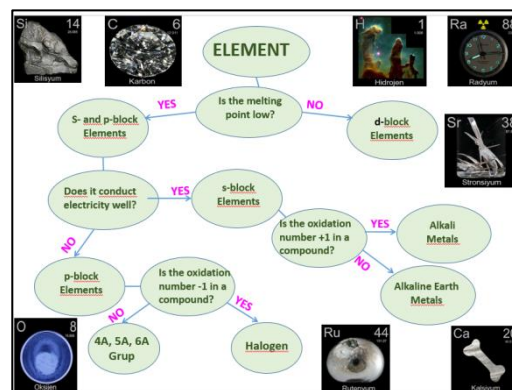


Figure 3. A flow diagram

### Spider Map

A spider map is a brainstorming or organizational tool that provides a visual framework for students to use. They can be used to show different aspects of a central idea and the supporting evidence for each of the aspects. For this reason, a spider map has a main idea or topic in the center, or the body, of the diagram. Each detail or sub-topic associated with the main idea has its own leg, or branch, surrounding the main idea.

### Compare and Contrast Chart

Comparing and contrasting things is a vital skill that students need to develop during elementary and middle school. Using a compare and contrast chart will help students engage in deep thinking in comparing two concepts, and learn how to use a graphic organizer to visualize likeness and differences between two things. There are lots of designs that can be used for comparing and contrasting.

### Persuasion Map

The Persuasion Map enables students to map out their arguments for a persuasive essay or debate (URL-1). Students begin by determining their goal and write their goal in the first box. They then identify three reasons to support their argument and write their reasons in the next boxes. Finally, they list facts and examples in branching boxes.

### Cause and Effect Diagram/ Fishbone Diagram

The Cause and effect diagram, also sometimes called the ‘fishbone’ diagram, is a tool for discovering all the possible causes for a particular effect. (URL-2). This diagram can also help in brainstorming to identify possible causes of a problem and in sorting ideas into useful categories.

## Conclusion

In this study, several graphic organizers have been prepared and explained how they can be used in secondary school chemistry lessons.

## Recommendations

The use of graphic organizers in the chemistry lessons can help teachers and students enhance meaningful learning and provide learning of complex and problematic topics easily (Hall, Strongman, and Meyer, 2003). Therefore, the graphic organizers are important for lessons. Students can remember concepts and topics easily if a graphic organizer use during the lesson. The students can also be arranged graphic organizers themselves for their lesson when they are taught. If the graphic organizers are taught to chemistry teachers during their education or in-service workshops, they can design their own graphic organizer and use them in their chemistry classes. For this reason, it is recommended that the explanations about how graphic organizers can be prepared are presented in the books or the workshops which will be organized for the in-service chemistry teachers. The courses about graphic organizers can be added to chemistry teacher training programs too.

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