THE EFFECT OF MULTIPLE INTELLIGENCES BASED INSTRUCTION ON NINTH GRADERS CHEMISTRY ACHIEVEMENT AND ATTITUDES TOWARD CHEMISTRY

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Approval of the Graduate school of Natural and Applied Sciences.

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Philosophy.

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Philosophy.

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ABSTRACT

THE EFFECT OF MULTIPLE INTELLIGENCES BASED INSTRUCTION ON NINTH GRADERS CHEMISTRY ACHIEVEMENT AND ATTITUDES TOWARD CHEMISTRY

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The main purpose of the study was to compare the effectiveness of multiple intelligences theory based instruction (MITBI) and traditional science instruction (TSI) on 9th grade students' understanding of chemical bonding concept and attitudes toward chemistry.

In the study, 50 ninth grade students from two classes of Genç Osman high school in Ankara were used. 25 of the students were assigned as experimental group and the other 25 as control group. They were instructed by

the same teacher. The study was conducted during May of 2005. The groups were selected from eight 9th grade classes of Genç Osman High School randomly. The students are at the ages between 14 and 16. The group which was assigned as experimental group was instructed by multiple intelligences theory based instruction (MITBI) whereas the other group was traditionally instructed. This experimental study took a period of three weeks. To determine the effectives of multiple intelligences based instruction over traditional science instruction, an achievement test about chemical bonding concept which consisted of 25 items were administered and an attitude scale toward chemistry developed by Geban et al., was applied. Science Process Skill Test was administered to investigate the relationship between the students' science process skills and their achievement.

For the statistical analysis, t-test, and Analysis of Covariance (ANCOVA) were used. The results showed that students who were instructed by multiple intelligences theory based instruction were achieved higher than the ones which were instructed by the traditional science instruction about chemical bonding concept. There was also a significant difference between the students instructed with Multiple Intelligences Theory Based Instruction (MITBI) and the students instructed with traditional science instruction (TSI) with respect to the attitudes of students toward chemistry. There was no significant difference between the attitudes and achievement of female students and that of male students. Students' science process skills had no greater contribution to their success.

Keywords: Multiple Intelligences theory, science education, chemical bonding, traditional science instruction, attitudes toward science, science process skills.

ÖZ

ÇOKLU ZEKA TEORiSiNE DAYALI ÖĞRETİMİN DOKUZUNCU SINIF ÖĞRENCİLERİNİN KİMYA BAŞARILARINA VE TUTUMLARINA ETKİSİ

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Bu çalışmanın başlıca amacı çoklu zeka teorisine dayalı öğretimin dokuzuncu sınıf öğrencilerinin kimyasal bağları anlama ve kimyaya karşı olan tutumlarına etkisinin geleneksel fen öğretim yöntemi ile karşılaştırmaktır.

Bu çalışma, Ankara'daki Genç Osman Lisesi'nin iki sınıfından toplam 50 dokuzuncu sınıf öğrencisiyle yapılmıştır. Bu öğrencilerin 25'i deney grubu, diğer 25 i de kontrol grubu olarak rasgele belirlenmiştir. İki sınıftaki öğrenciler de aynı öğretmen tarafından okutulmaktadırlar. Bu çalışma 2005 yılının 2. döneminde yapılmıştır. Çalışma için seçilen öğrenciler Genç Osman Lisesinin sekiz

sınıfından ikisi olup yaşları 14 ile 16 arasında değişmektedir. Deney grubu olarak belirlenen grup çoklu zeka teorisine dayalı öğretim metodu ile eğitilirken diğer grup geleneksel öğretim metodu ile eğitilmiştir. Bu çalışma üç hafta sürmüştür. Çoklu zeka teorisine dayalı öğretim metodunun geleneksel öğretim metodundan daha etkili olup olmadığını anlamak için, 25 sorudan oluşan kimyasal bağlar başarı testi ve Geban ve melektaşları tarafından geliştirilen bir kimya tutum ölçeği uygulanmıştır. Öğrencilerin bilimsel işlem beceri yeteneklerinin başarılarına bir katkısı olup olmadığını inceleyebilmek için bir bilimsel işlem beceri testi uygulanmıştır.

İstatiksel analizler için, t testi ve ANCOVA kullanılmıştır. Sonuçlar, çoklu zeka teorisine dayalı öğretim metodu ile eğitim gören öğrencilerin kimyasal bağlar konusunda, geleneksel öğretim metodu ile eğitim gören öğrencilerden daha başarılı olduğunu ortaya çıkarmıştır. Öğrencilerin kimyaya karşı olan tutumlarında da anlamlı bir fark gözlenmiştir.

Anahtar kelimeler: Çoklu zeka teorisi, kimya eğitimi, kimyasal bağlar, geleneksel öğretim metodu.

To my husband, my baby, my mother in-law and my family, thank you for your love and support.

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PREACH	: Pre achievement scores
PREATT	: Pre attitude Scores
POSTACH	: Post achievement Scores
POSTATT	: Post attitude Scores
ANCOVA	: Univariate Analysis of Covariance
MIBI	: Multiple Intelligences Based Instruction
TSI	: Traditional Science Instruction
CBAT	: Chemical Bonding Achievement Test
ASTC	: Attitude Scale towards Chemistry as a School Subject
SPST	: Science Process Skill Test
df	: Degrees of freedom
SS	: Sum of squares
MS	: Mean square
$\bar{X}$	: Mean of the sample
P	: Significance level
F	: F statistic
t	: t statistic
n	: Sample size
α	: Significance Level

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CHAPTER I

INTRODUCTION

Individuals are the main source of improvement of the society and sustainability of its presence if they grown up appropriately. Education being a bridge between human and the life is impressed and shaped by the developments of era, so education of individuals become important parallel with the progress and changes in the society.

Teachers should plan science education with respect to their students. For a qualified science education, the curriculum should be planned according to the interests of students. It does not only motivate students but also make them learn the subject in an effective way. According to Colleta and Chiapetta (1994), science education should be related with the attitudes and interests of the students. These psychological concepts help motivate students and make the educational process more pertinent. Bybee (1993), also agree that curriculum and instruction should be integrated with the interests and ethical backgrounds of the students. They should guide learning toward (1) understanding and fulfilling basic human needs and facilitating personal development; (2) maintaining and improving the physical environment; (3) conserving natural resources so they are used wisely; and (4) developing and understanding the interdependence among people at local, national and global levels- that is a sense of community.

From the extensive literature, it is obvious that students will learn better if they actively participate in educational process. According to Sanfeliz and Stalzer (2003), one way to help students become active agents in their society is by making the educational experience more pertinent, especially regarding science.

Students can be motivated to learn a scientific concept and discover the importance that such experience has to offer. If the student has the chance to learn what they find interesting in science, children will feel a sense of control and greater responsibility and enthusiasm toward their learning.

Chemistry is an important subject as a branch of science. The world is filled with the products of chemical studies. The basis of all chemical studies starts with chemistry education. Dori and Hamairi (2003) claim that chemical education is a complex human endeavor which involves deep understanding of diverse concepts and requires a mental transfer between several modes of representation. According to Gregory and Richard (2002), chemistry learning involves establishing conceptual relationship among macroscopic, microscopic, and symbolic representations.

Chemistry teachers have the big responsibility to make students love and learn subject chemistry well. They should learn new ways to make chemistry interesting and fun for their students. Whatever science background teachers have, they should find new tools and resources to improve the quality of chemistry education for all students.

Chemistry education in Turkey is not given the importance it deserves. Chemistry is an experimental science, so chemistry classroom schedules must be done with the experiments in laboratories. However, there are not enough laboratories for chemical experiments in secondary and high schools. The equipment is not sufficient for investigations. There are not visual materials to learn chemistry in an effective way. According to Çırakoğlu (2003), because of the limitations of the special foundations and the low capacities of them, limitations of laboratories' capacity and tools, and not taking the sources necessary for them, unfortunately the students are not grown up qualitatively.

Multiple intelligences theory refers to a theory of intelligence developed in the mid-1980s by Howard Gardner, who is a professor of education of Harvard University. He defines intelligence as "the ability to solve problems or fashion products that are valued in at least one culture." IQ tests, he points out, cannot measure the value of a product or one's ability to produce a product. He informs that humans possess a number of distinct intelligences that manifest themselves in different skills and abilities. All human beings apply these intelligences to solve problems, invent processes, and create things (Gardner, 1983).

Gardner and his colleagues (2003) searched thoroughly the literature from brain study, genetics, anthropology, and psychology in an effort to ascertain the optimal taxonomy of human capacities. They identified some important points and decided to call these faculties as “multiple intelligences” rather than abilities or gifts. He thought that if he called them as seven talents, it would not have received much attention that “Frames of Mind” received. A second crucial turning point was the creation of a definition of intelligence and the identification of a set of criteria that define what is, and what is not, intelligence. He felt that the definition and the criteria are among the most original parts of the work; but neither has received much discussion in the literature. They developed multiple intelligences theory.

Gardner’s theory of multiple intelligences includes the following four premises (Chapman & Freeman, 1996)

1) There are more than two types of intelligence. Gardner has named eight.
2) Intelligence can be taught. Areas of weakness and strengths can be improved.
3) A brain is a unique as a fingerprint. Each person is born with all Intelligences.
4) Intelligences are forever changing throughout life. .

Eight intelligences Gardner identified are: verbal-linguistic, logical-mathematical, musical-rhythmic, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal and naturalist. Everyone has these intelligences in different proportions.

According to Gardner,

- All human beings possess all nine intelligences in varying amounts.
- Each person has a different intellectual composition.
- We can improve education by addressing the multiple intelligences of our students.
- These intelligences are located in different areas of the brain and can either work independently or together.
- These intelligences may define the human species

Gardner (2003) proposes the existence of new intelligences including spiritual, and existentialist. His colleague Antonio Battro has proposed the existence of a digital intelligence and spiritual intelligence which is the intelligence of big questions and has indicated how it may fulfill the criteria that Gardner has set forth.

Chemical bonding is a chemistry course topic that students struggle to understand as it is an abstract concept. Researchers agree that students struggle to understand scientific concepts, such as the particulate nature of matter and the mole. Students also encounter difficulties while interpreting chemical symbols. (Dori & Hamairi, 2003). In the studies made about chemical bonds, it is figured out that students are in difficulty in understanding the types of chemical bonds, they confuse intra and intermolecular bonds, and they have misconceptions about the

bond and molecule polarity, molecular structure and the network of the matter (Peterson, Treagust, and Garnet, 1989; Tan, Treagust, 1999; Nicol, 2001; Özmen, 2004; Ürek & Tarhan, 2005).

In Turkey, students are faced with the chemical bonds and reaction concepts in 8th grade of primary school, then, they develop it in high school and general and organic chemistry courses of university chemistry.

In this study, Multiple Intelligences theory based instruction and the traditional instruction methods were compared. The effectiveness of the multiple intelligences based instruction was tried to be proved. Students' attitudes toward chemistry and multiple intelligences of students was tried to be improved.

1.6 Significance of the Study

MI theory has been becoming a popular theory nowadays. It is a student centered method. In the related literature, most of the researchers and educators agree that student centered methods are more successful than the traditional methods. Because, in student centered methods, students' interested areas, active involvement, their ages, their ethical backgrounds, and the other factors related with the students are considered. So, the full potential of the student and the success was tried to be obtained.

In this study, Multiple Intelligences Theory (MIT), which is a student centered method, was used. So, it is expected that the students with MIT based instruction will be more successful. When MIT is used as an instructional method, the instruction will be rescued from monotonous. Students will reveal their strengths, their gifts, and intelligences and the most important they will love the science. Students will choose the career that most fit to their strengths, interests and abilities.

This study has benefits for several reasons. It will guide students to notice their interested areas and their strong intelligences and will improve their hidden ones. Also, parents will notify their student's weaknesses or strengths and behave in that aspect. They will not force their child to be logic or linguistic smart. They will help their children to choose his/her interested areas and become satisfied with the life and enjoy what to do.

This study will also orientate educators to use most productive ways that a topic can be taught. By the guidance of applications of multiple intelligences like this study, they will increase their repertoire according to their students' needs and interests.

In Turkey, no study related with the effects of MI on 9th grade students understanding of chemical bonds and attitudes toward chemistry have been found so far. The result of this study will prove the effects of MI on student achievement. It will guide some inquisitive Turkish teachers to make use of the result of this study in order to obtain better results in teaching of a specific subject and having no problem with the management of class. Also, the students will enjoy course sessions. They will be reinforced by laboratory schedules, projects, visual materials, presentations, group works, discussion and full-up activities that will facilitate students.

CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 Views about Intelligence

The definition of the word “intelligence” has been discussed for many years. Intelligence has traditionally been defined in terms of intelligence quotient (IQ), which measures a narrow range of verbal/linguistic and logical/mathematical abilities (Christison, & Kennedy; 1999). According to Binet, intelligence is the ability to use language and do mathematics. It is a uniform cognitive capacity people are born with. This theory states that people are born with a fixed amount of intelligence and the level of intelligence does not change over a lifetime. Only verbal and mathematical skills are considered as intelligence. His definition of intelligence has been accepted as traditional definition of intelligence. Whole educational systems were built on Binet’s understanding. His tests marked the students for life (Chapman, Freeman; 1996). In traditional view, the subject is taught to all students in the same way without considering their different capacities or different ways of learning. By answering items on intelligence tests it has been thought that intelligence was a general ability that could be measured with standardized pencil and paper tests; and in turn would be able to predict school achievement. (Çoşkungönüllü, 1998, p3)

There are other researchers that describe intelligence. According to Li (1998), Intelligence is the mental capacity for higher order conceptual activities of thinking and the acquisition of knowledge (as cited in Gagne, 1998). Li describes gifted children as those processing supernormal intelligence and are capable of creative thought. They think better, learn faster and are capable of speedy

imitation, efficient understanding, swift automatic processing and the creation of low and novel ideas. His view of intelligence is also parallel with the traditional view. Linguistic and conceptual fluency are indicators of giftedness. Everybody has gifts. Giftedness is a potential and becoming concept. Education can enhance creativity and giftedness because creative thinking an outgrowth of conceptual thought can be taught and learned.

Plotkin (2001) defined Intelligence as a form of biological adaptation, often species-specific in manifestation. It is a trait that generates adaptive behavior by altering brain states the configuration of which corresponds to memory and is related to some specific feature(s) of the environment.

Recently, new intelligence definitions and theories have been stated. Sternberg and Grigorenko's successful intelligence theory (2004) is one of these. They developed the theory of successful intelligences to understand the children who fail to learn at a level that matches their ability to learn. According to the theory, successful intelligence is the use of an integrated set of abilities needed to attain success in life. Successfully intelligent people adapt to, shape, and select environments. In adaptation, they change themselves to fit the environment.

Sternberg's successful intelligence is complementary to the Gardner's theory in the sense that any of Gardner's domains can employ analytical, creative, or practical processes. But there are some differences. One of them is that the theory of successful intelligence has been subject to many controlled studies seeking empirically validating it, while Gardner's theory has not. A second difference is that the theory of successful intelligence is more process-oriented while Gardner's theory is more content oriented. And a third difference is that not all of Gardner's theory fall under the purview of the theory of successful intelligence, such as the candidate "existential intelligence."

Blythe and Gardner (1990) report some challenging ideas to the other educational practices. They propose four compellineg alternatives of multiple intelligences theory to current educational practices in several areas:

1. Range of abilities addressed. According to MI theory, it is important to address other human abilities and talents besides the linguistic and logical mathematical intelligences which have long been the primary focus of most school.
2. Learning environment. By acknowledging the wide variety of valuable and independent domains, MI theory calls for an attendant shift in instructional conditions.
3. Assessment measures. MI theory challenges the viability of standardized, machine-scored multiple choice assessments, which by their very nature appraise students' knowledge through the filter of the linguistic and logical mathematical intelligences. Every intelligence needs to be assessed directly.
4. Concept of Learner. By proposing that each person possesses distinctive combination of intelligences, MI theory emphasizes the highly individualized ways in which people learn.

2.2 Multiple Intelligences Theory

Nowadays, Multiple Intelligences theory has been becoming more popular so that it has been attracting so many educators and researchers. One of these researchers, Campbell (1991) says:

> "Gardner's theory of MI immediately took root in the educational community. It offered a theoretical foundation of the mind and bolstered beliefs about student's competence. It extends the traditional view of intelligence

as solely composed of verbal/linguistic and logical/mathematical abilities."

Most of the researchers and educators who are the proponents of multiple intelligences theory inform this fact.

Multiple intelligences theory has obvious educational implications, and several schools have restructured their curricula with its domains in mind. The Key School in Indianapolis (Blythe& Gardner, 1990) The Mather School in Boston (Hatch, 1993), and the New City School in St.Louis (Hoerr, 1994) are three examples of schools that have used Gardner's theory in reforming their curricula.

Multiple intelligences theory maintains that all humans possess at least eight different intelligences that represent a variety of ways to learn and demonstrate understanding. According to the Christison (1999), MI theory provides a way of understanding intelligence, which teachers can use as a guide for developing classroom activities that address multiple ways of learning and knowing.

In an effort to create logical theories, students use a number of multiple intelligences in a neutral flow of learning: the logical/mathematical intelligence is used in their reasoning sequences, the verbal/linguistic is used in the justification process, the interpersonal/ social intelligence is used in cooperative learning groups, and the visual/spatial intelligence is used with Venn diagrams that compare and contrast theories. The intrapersonal/introspective intelligence is used in journal writing, a process that helps students reflect on their learning and apply ideas from class discussions to their readings. At the end of the unit, each group uses their musical/ rhythmic intelligence to create a song about their theory-making process (Fogarty, Stoehr, 1995).

Gardner based his list on findings from neurology, developmental and cognitive psychology, and anthropology. He argued that these intelligences can be shown to be localized in the brain; that they are exhibited in extreme form by idiot savants, prodigies and geniuses; that have a clear developmental history, and that they are used in the performance of roles that cultures value around the world (Collins, 1998).

Armstrong (1994) states that the theory of multiple intelligences is a new model of learning to help students learn effectively. Students should be learning their algebra, ancient history, government, chemistry, literature and more through multiple intelligences. The students should be role playing literature. They should be interviewing, surveying, building, and dramatizing, rapping, cooperating, computing, problem solving, sketching, and learning in a thousand other ways. According to Armstrong, we could see many more intelligences if we travel the world and look at the many ways in which different cultures show their capabilities. The theory of multiple intelligences makes things a little simpler for us. By chunking the broad range of human abilities into seven basic intelligences, we now have a map for making sense out of many ways in which children learn and a blueprint for ensuring their success in school and in life.

Hoer (2002) indicated that multiple intelligences theory has two powerful lures so that many educators supported it. First, when viewed through an MI lens, more children succeed. A second future of MI, one which may not be as obvious, is that using MI transforms the role of the teacher. That is, the teacher does not explain the topic, he becomes facilitator or guider.

Some of the researchers and educators believe that this learning philosophy works fine with younger kids but that when students reach middle age or high school age, they need to put these frills aside and get serious about

learning. Armstrong claims that this restricted perception of learning makes people estrange to the adolescents. Children do not leave their multiple intelligences behind once they reach puberty, even the intelligences become denser, especially bodily-kinesthetic and the personal intelligences (1994).

Armstrong (1994) declared four key points in MI theory:

1. Each person possesses all eight intelligences.
2. Most people can develop each intelligence to an adequate level of competency.
3. Individuals usually work together in complex ways.
4. There are many ways to be intelligent within each category.

Durie (1997) conveys that MI can not be an educational end in itself. MI is, rather a powerful tool that can help us to achieve educational ends more effectively. According to him, multiple intelligence theory is most useful for two educational ends:

1. It allows us to plan educational programs that will enable children to realize desired end states.
2. It helps us to reach more children who are trying to understand important theories and concepts in the disciplines.

Gardner states eight criteria to identify intelligence. Theses are:

- potential isolation by brain damage/neurological evidence
- evolutionary history and evolutionary plausibility
- an identifiable set of core operation(s)
- susceptibility to encoding in a symbol system
- recognizable end-state and distinctive developmental trajectory

- existence of savants, prodigies, and other individuals distinguished by the presence or absence of specific abilities
- Support from experimental psychological tasks,
- support from psychometric findings.

Gardner expanded the concept of intelligence to areas as music, spatial relations and interpersonal knowledge in addition to mathematical and linguistic ability. All societies value different kinds of intelligences. Thus, while particular intelligences might be highly evolved in many people of one culture, those same intelligences might not be as developed in the individuals of another.

Multiple Intelligences theory is also used in web based instruction. According to Osciak and Wilhelm (2001), by utilizing Web design principles and understanding the types of learning technologies available, educators, instructors and instructional design professionals can create instruction that meets and exceeds expectations, creating opportunities to incorporate activities that appeal to the eight intelligences and thereby increase learner responsiveness. Nelson (1998) states that with its accessibility, and user friendliness, web-based instruction is probably one of the most flexible types of instruction, providing a forum where all intelligences can be represented and cultivated regardless of the physical location of the students.

Eight intelligences that Gardner developed are verbal-Linguistic, logical-mathematical, visual-spatial, bodily kinesthetic, musical-rhythmic, interpersonal, intrapersonal and naturalist intelligence. The profiles of intelligences and the information related with them are given in the following.

Verbal-Linguistic Intelligence

Children (or adults) who demonstrate strength in the language arts: speaking, writing, reading, listening have this intelligence, which sometimes called as word smart or book smart. It involves understanding the order and meaning of words in both speech and writing and how to properly use the language. Linguistic intelligence can be exercised and enhanced in playful ways in the classroom through jokes, puns, satires, funny stories and anecdotes. When a child or an adult has this intelligence, he understands the nuances of a language, including idioms, plays on words and humor based on language.

Verbal-linguistic students need to process content information through spoken or written words. Their comprehension comes from the creation and the digestion of words (Fuini, & Gray; 2000). They like discussions, debating, speaking, and creative writing, playing word games, i.e puzzles, making stories and telling jokes.

Logical- Mathematical Intelligence

People who display an aptitude for numbers, reasoning and problem solving have this kind of intelligence. This intelligence can easily be identified as the ability to recognize long strings of numbers, possessing a considerable reasoning ability; drawing upon heuristic appropriately and having a sense of solution or direction of complex problems. (Coşkungönüllü, 1998).

Logical-mathematical learners need to see patterns in their learning to organize their information (Fuini, & Gray; 2000). Children who have this intelligence use numbers, mathematics and logic to understand and solve the problems effectively. They try to understand concrete patterns and relationship between these patterns. They like to solve puzzles and problems. They try to find logical answers for everything and do everything with logic.

Visual-Spatial Intelligence

Children who can learn best visually and organizing things spatially have this kind of intelligence. They like to see what you are talking about in order to understand the subject well. They enjoy charts, graphs, maps, tables, illustrations, art, puzzles, costumes, colors, anything related with sight. Cartoons, witty posters, and funny pictures related to the subject to be taught convey a message about learning to these students. For many of them, that message may also be more memorable and easily understood than it might in another form. Visual-Spatial intelligence can also be developed as students are encouraged to try their hands at cartooning or making illustrations related to any subject-matter.

Visual-Spatial learners need to see what they are learning. They have a unique ability to give concrete form to what they see in their mind's eye. They learn best through the use of color and many different audiovisual media (Fuini, & Gray; 2000). They learn by visualizing, imagining and forming mental images in mind. Jigsaw puzzles, maps, colors, decorations attract these students strongly.

Bodily /Kinesthetic intelligence

Children who experience learning best through activity: games, movement, hands-on tasks, building have this intelligence. These children were often labeled overly active in traditional classrooms.

As students engage in funny actions--making their bodies into the shapes of periods, commas, and question marks--or creating an "action" sentence with each student being a part of speech--or acting out funny mathematical story problems--their bodies help them to understand and remember.

Bodily-kinesthetic learners need to be active in order to gain the greatest comprehension. Students need to be involved in movement or in the manipulation of the objects to maximize their ability to focus and process information. Role

playing encourages creative interpretation and the expression of positive feelings; it also enhances students' decision-making skills (Fuini, & Gray; 2000). The students that have this intelligence learn by doing, touching, moving. They like the activities that require physical movement as dancing, role-playing, discovering things with their hand. These students become bored if they are compelled to sit for long periods of time.

Musical-Ryhtmic Intelligence

Children who learn well through songs, patterns, rhythms, instruments and musical expressions have this kind of intelligence. Musical puns are an interesting way to help students sharpen their listening skills and improve concentration. Students can also make up funny songs that help them remember historical events or geographical locations or mathematical facts. Needless to say, their musical intelligence is also exercised in the process. Funny songs can also add warmth and a welcoming atmosphere to the classroom environment as students enter the room.

Musical-rhythmic smart students learn best when there is a musical beat to the information. These are the people who are always humming or tapping to a beat and can not get songs or jingles out of their heads (Fuini, & Gray; 2000). The students who are strong in this intelligence like music, and rhythmic patterns, they are sensitive to the sounds in the environment. They have the musical ear, so that they easily recognize different musical patterns, and instruments.

Interpersonal Intelligence

Children who are noticeably people oriented and outgoing, and doing their learning cooperatively in groups with a partner have this intelligence. Interpersonal intelligence can be developed by making students work in pairs as a funny and a

straight person. Analyzing videos of some of the old comedy teams will help students to recognize, through caricature, different kinds of interpersonal skills and the importance of timing in clever repartee. Students can then try doing their own version of some of the skits. Such exercises are excellent ways to develop self-confidence in front of an audience, as well as the ability to collaborate spontaneously.

Interpersonal-smart learners need to interact with others to be most successful while processing their information. (Fuini, & Gray; 2000). So, cooperative learning strategy best fit these students in learning. These children may have lots of friends and peers, show great ability to make empathy with the others.

They learn by interacting, and talking with people.

Intrapersonal Intelligence

Children who are especially in touch with their own feelings, values, and ideas have this intelligence. They may tend to be more reserved, but they are actually quite intuitive about what they learn and how it relates to them. As a matter of fact, the ability to understand ourselves better by being able to laugh at our foibles or mistakes is a non-threatening way to greater self-understanding. Students will be well-served by learning that making an honest mistake should not automatically lead to self-depreciation or shame or anger. When we are able to laugh at ourselves, we are much better able to pick ourselves up and start over.

Intrapersonal learners need to reflect on their learning privately, as they have an inner strength that helps them increase their understanding. (Fuini, & Gray; 2000) So, for these students, individual works, projects can be most useful. Children, who have this intelligence like to work alone, shy away from others. They

have deep understanding of their feelings, emotions, values, and beliefs. They are intrinsically motivated. Probably other people come to them for their advice.

Naturalist Intelligence

Naturalist intelligence is an ability to discern, identify and classify plants and animals. This ability would make it easier to live off the land and so on. According to Durie (1997), the core of the naturalist intelligence is the human ability to recognize plants, animals, and other parts of the natural environment like clouds or rocks. Each of the original seven intelligence draws upon patterning skills to interpret the sights and sounds of the world around us.

Naturalist intelligence deals with sensing patterns in and making connections to elements in nature. Children possessing this type of intelligence may have a strong affinity to the outside world or to animals, and this interest begins at an early age. Their heightened senses may help them notice similarities, differences and changes in their surroundings more rapidly than others (Wilson, 1998). Naturalist learners need to see connections between their leaning and the natural word. These students would be strong in science and nature concepts (Fuini, & gray; 2000).

Chapman (1996) in his book “MI centers and Projects,” describes the naturalist intelligence as one’s ability to adopt and survive in one’s environment. His understanding of nature includes such abilities as identifying, taking care of and enjoying the land, sea, and the sky and being able to take one’s place and survive there. The person with the green thumb and the farmer who can make the land produce at its highest level have strong naturalist capabilities. A person who can label and identifies kind of trees, wildflowers, plants, birds, animals and other natural things also demonstrates this intelligence among the group of scientists,

such as sailors, navigators, astronomers, biologists, environmentalists, park rangers, landscape artists, zookeepers and veterinarians.

There are some educators who combine multiple intelligences theory and other instructional methods or educational ideas. One of them is Soares. According to Soares (1998), there are some solutions in the actual practices of teachers. A unique combination of The Copernican Plan for block Scheduling, The application of Howard Gardner's theory of multiple intelligences, and John Dewey's basic ideas about process creates a different configuration in teacher preparation that yields ideas for reform of the present system. Soares states that by the combination of these three perspectives there is a model of structure, content, and process that improves the delivery of instructional services.

2.2.1 Applications of Multiple Intelligences Theory

Up to now, there have been so many applications of multiple intelligences theory in different areas and different subjects all over the world. Multiple intelligences theory has several implications for teachers in terms of classroom applications. Therefore, teachers should think of all intelligences as equally important (Brauldy, 1998). However, traditional systems place strong emphasis on the development and use of verbal and mathematical intelligences.

Brauldy (1998) states that an implication of the theory is that the teachers should structure the presentation of materials in a style which engages most of the intelligences. By activating wide assortment of intelligences, teaching can facilitate a deeper understanding of the subject material. Brauldy maintains that everyone has all kinds of intelligences. Nevertheless, all students come to class with different sets of developed intelligences. Therefore, it is impossible for teachers to accommodate every lesson to all of learning styles found within the classroom.

Nevertheless, the teacher can show students how to use their more developed intelligences.

Armstrong (1994) declares that the theory of multiple intelligences has broad implications for team teaching. In a school committed to developing students' multiple intelligences, the ideal teaching team or curriculum planning committee includes expertise in all eight intelligences that is; each member possesses a high level of development in a different intelligent.

Some educators may think that multiple intelligences theory has been embraced by many elementary and some middle schools, but the acceptance is rarer in high schools. Campbell does not agree with this fact because he thinks most comprehensive secondary programs have courses in all intelligences and teacher who have been identified as intelligence experts by the subjects they teach (Campbell, 1991).

Another defender of this idea is Haas. According to Haas (2005), multiple intelligences theory also has enormous implications for the corporate environment. Many adults find themselves in jobs that do not make optimal use of their intelligences. Employers who have little awareness or understanding of personality typology and multiple intelligences cannot lead effective and do not get the best of their team.

Campbell (1991) implemented Gardner's theory of multiple intelligences by organizing his third grade classroom in Marysville into seven learning centers, each dedicated to one of the seven intelligences. The students spend approximately two-thirds of each school day moving through the centers. Curriculum is thematic, and the centers provide seven different ways for the students to learn the subject matter.

All students learn each day's lesson in seven ways. They build models, dance, make collaborative decisions, create songs, solve deductive reasoning problems, read, write and illustrate all in one school day. The centers Campbell organized are;

Personal Work Center (Intrapersonal Intelligence)

Working Together Center (Interpersonal Intelligence)

Music Center (Musical Intelligence)

Art Center (Spatial Intelligence)

Building Center (Kinesthetic Center)

Reading Center (Verbal / Linguistic Center)

Math & Science Center (Logical Mathematical Intelligence)

After working at the centers, students share their work. Remainder of the day is spent with students working on independent projects either individually or in small groups. With his study, he states that students improved positive behaviors and skills.

According to Campbell, the reasons for the academic and behavioral success of the program appear to be twofold. First, every student has an opportunity to specialize and excel in at least one area. Secondly, each student learns the subject matter in a variety of different ways. Their intellectual needs are met by constantly being challenged and frequently exercising their creativity.

The emphasis in Campbell's program is upon learning rather than teaching in his style of speech. He believed that teaching and learning through multiple intelligences helps solve many common school problems and optimizes the learning experience for students and teachers alike.

According to White (1997), every child has much strength in some areas that are overlooked. She tries to uncover these hidden treasures of children. When a child, she loved reading, wrote and produced plays for her family and friends, composed stories using her friends as the characters and did well on verbal exams. She means she is a verbal- linguistic child. However, her brother Keith as an interpersonal child loved making friends, knowing lots of people, helping everybody who needs help, being an active member of a community. She concludes that these differences are because of different gifts given to them and different ways of knowing. Their mother helped them more in their own way without knowing their strengths and she claims that her mother was a proponent of the theory of multiple intelligences not knowing anything about the theory. She thinks that everyone has talents or gifts in many areas, and when we play to our strongest suits, the most effective learning usually occurs (White, 1997).

Chan (2003) made an investigation of six hundred and thirty nine Chinese primary and secondary gifted students on their adjustment problems using the revised Student Adjustment Problems Inventory (SAPI). He concluded that less salient was the problem of poor interpersonal relationships. While the notion giftedness and vulnerability to adjustment problems was not born out by the data with traditional IQ measure, specific adjustment were found to be associated with specific intelligences. According to the findings, Chan stated that students reported highest scores on the two personal intelligences, followed by the conventional verbal and mathematical intelligences and musical intelligence, and they scored lowest on the visual-spatial, naturalist, and bodily-kinesthetic intelligences. He found that different multiple intelligences related differently to different adjustment problems. According to Chan, perhaps more compelling were the findings that conventional intelligences (verbal and mathematical intelligences) did have an

effect on problems related to Intense Involvement and Unchallenging Schoolwork, whereas personal intelligences (intrapersonal and interpersonal) could help reduce vulnerability to problems related to Poor Interpersonal Relationships.

Cifuentes & Hughey (2005) investigated the differential effect of computer conferencing on expository writing for students of seven intelligence types. They assigned students to treatment groups that provided controlled exposure to a topic unstructured exposure; computer conferencing; face to face discussion. All students are classified according to their intelligence types and then wrote an essay on the topic. At the end of the study, according to the result of Manova measurement, they concluded that participation to computer conferencing about a specific topic did not significantly improve scores on essays about that topic. However, measurement identified interactions between treatment group and multiple intelligences. Correlations revealed that students with interpersonal intelligence who participated in face-to-face discussions but did not computer conferencing on the writing-prompt benefited benefited from such treatment. Students with intrapersonal intelligence were negatively affected by the combination of computer conferencing and face-to-face discussion on both writing content and overall composition. However, computer conferencing alone and face-to-face alone did not negatively affect intrapersonal intelligence types' writing. Students with bodily kinesthetic intelligence were negatively affected on overall composition by computer conferencing without face to face discussion. However, when these students participated in both the computer conferencing and face to face discussions, they were not negatively affected. Cifuentes & Hughey's findings can orientate us about the characteristics of all intelligence types and behave in that way.

Kassell (1998) also sets a relation between music and multiple intelligences. He reports some misguidences and problems of music activities based on this theory. He says that the publication of “Frames of Mind”, music educators welcomed that book as they think it as the confirmation of the idea that paper and pencil linguistic tests and logical-mathematical tests are not the measure of intelligence. According to Kassell, much of the multiple intelligences literature suggests exercises that link memorizing academic content with rhythms or simple songs. One reason is that music is a tool for enhancing memory. Another reason educators should be concerned is that this type of repetitive drill and practice fails to lead students to what Gardner calls “genuine or performance understandings”. The theory provides for music educators to engage in a dialogue that encourages each of them to examine more closely and reflect more deeply on the purpose of education, their practice, and their philosophical belief. (Kassell, 1998, p29)

Metteal, Jordan, & Harper (1997) examined the impact of MI curriculum in a large suburban elementary school. They observed students, surveyed parents, interviewed of students, parents, teachers, administrator’s instruments. They obtained three results form these investigations. First, students, teachers and parents were very positive about the concept of multiple intelligences. Second they were positive about school wide implementation, including flow time, activity room and enrichment clusters. Third, classroom implementation of multiple intelligence concepts was uneven across classrooms.

In Turkey, Akbaş (2004) made a study called “The Effects of Multiple Intelligences Based Instruction on Six Graders’ Science Achievement and Attitudes toward Science”. His study was an experimental type study conducted in 2nd term of 2002-2003 educational years with six grade students of METU Ankara College

Primary School and lasted for three weeks. He used science achievement test and science attitude scale. At the end of the study, he justified the idea that the multiple intelligences based instruction was more effective than the traditional instruction. However, the statistical analysis indicated no significant result about students' attitudes toward science.

Aşçı (2003) investigated the effects of multiple intelligences based instruction on ninth grades students' ecology achievement, their attitudes toward ecology, and their multiple intelligences. She made an experimental study which consists of two groups called experimental group and control group. She applied Ecology Achievement Test, Ecology Attitude Scale and Multiple Intelligences Inventory. She analyzed the results with MANCOVA and concluded that the multiple intelligences based instruction is more effective than the tradtitional instruction in terms of achievement and multiple intelligences; however she found no significant results between the two groups.

Weber (2000) reports several reasons for lack of interest in higher education, and introduces a PBL model to address and help resolve this problem. He applied the MITA model to resolve problems of student passivity in higher education classes of 260,000 freshmen by UCLA's Higher Education Research Institute. They showed that MITA model can help students positively to solve problems.

Katz, Mirenda, and Auerbach (2002), investigated the engaged behavior and social interactions of 10 students with developmental disabilities in two types of inclusive classrooms which are the one ascribed to MI pedagogy, instruction, and assessment and the one that used no specific educational theory or approach to instruction. They found at the end of the study that the experiences of the participants in both typical and MI-inclusive classrooms were more alike than

different. They observed more frequently the participants in the MI classroom to be engaged in multiple response activities. They observed the participant in MI classrooms spent more time interacting with their typical peers, whereas those in typical classrooms spent more time interacting with adults during 1:1 activities that were different from those of their peers.

Hart (1999) tried to put the academic concept that the children have trouble to music, like kassell with a group of elementary school children. With the help of a number of classroom and elementary music teachers, he tested more than hundred children in grades 3 to 5 tested with a sample of songs that teach academic concept. When he combined music with the traditional verbal linguistic (lecture) approach, he saw that the test scores improved by 13% and their retention increased by 12%. At the end of this process, he concluded that the music is a powerful tool for reaching children and that the more senses children can use in learning, the richer their learning experience will be. He recommends music educators to be in the forefront to help others understand the power and value of music by helping them use musical activities in their own teaching (p38).

Tertemiz (2004) applied Multiple Intelligences Theory to the 2nd grade students "Vehicles and Traffic" unit of two private schools with an experimental study. She tries to integrate the goals and target behavior related to Domestic Sciences, Turkish Language, Mathematics courses in terms of Multiple Intelligences Theory. She used worksheets, trips, observations and project activities. At the end of the study she concluded that the achievement of the experimental group has slightly increased.

An application of multiple intelligences theory in media is the project Martin, and Burnette, (2000) have improved. According to the researchers, an electronic portfolio can be an instrument to both establish baselines as well as to measure

growth in all of the intelligences Gardner has identified. As it could better reflect the students' development, an electronic portfolio is the only way to measure growth in all of the intelligences. According to Martin, the effectiveness of an activity is increased by addressing more multiple intelligences. Therefore the effectiveness of an activity is proportional to the number of intelligences addressed. An additional factor is the amount of time spent on an activity. He says if the time spent on an activity is decreased and achieve the same result, its effectiveness increases.

2.2.2 Assessment Projects Made about Multiple Intelligences Theory

There are some projects applied related with the theory of multiple intelligences. These are; Harvard Project Zero, Project Spectrum, Key School Center, PIFS, and Arts Propel. Gardner, in his book "The Theory in Practice" enlightens these assessment projects. In the following, these projects will be explained briefly in the view of his book.

Harvard Project Zero was founded by philosopher Nelson Goodman in 1997 at Harvard Graduate School of Education. He challenged the widespread notion that linguistic and logical symbols had priority over other expressive and communicative system. This project has involved 100 researchers and these people made contributions to humanities and social sciencies. (Gardner, 1993)

Project Spectrum, which is a long term project undertaken by Gardner and his colleague David Feldman and several researchers at Harvard project zero, is an innovative attempt to measure the profile of intelligences and working styles of young children. It was administered in two preschool classrooms at the Eliot-Pearson Children's School at Tufts University in Medford, Massachusetts. This project begins with the assumptions that every child has the potential to improve

strength in one or several other areas. In a spectrum classess, there are many productive materials that evoke the children's intelligences. In this classess, there is a naturalist corner, story-telling area, building corner (Gardner, 1993). In this program, several assessment instruments were used. They include creative movement experiences for bodily-kinesthetic learners, a dinosaur board game involving rolling dice, counting moves, and calculating strategies for logical-mathematical learners; a storyboard activity for visual-spatial learners. In the program, portfolios, teacher's observations of children are used (Armstrong, 1994).

Key School Setting Project is a kindergarten to high school program that is part of the Indianapolis Public schools in Indiana. In this program, educators use videotapes extensively in the assessment of learning progress. Students are videotaped while they are presenting their learning projects. These videotapes are used for giving grades to the students, providing information for parents, teachers, administrators and students (Armstrong, 1994). Every student at the Key School participates on a regular basis in the activities of computing, music, and bodily kinesthetic, in addition to theme-centered curricula that embody and the standard literacies and subject matter (Gardner, 1993).

The Practical Intelligence for School (PIFS) is another project about multiple intelligences theory to identify how best to prepare students at risk for school failure for successful performance in school. It was designed to develop and test a multifaceted model of practical intelligence for school (PIFS) and to determine how the academic intelligences work together and to examine the relationship of academic success to the functions of adaptation to, selection and shaping of environments (Gardner, 1993). In this project, activities such as, choosing a project, finding the right mathematical tools, notetaking, and why go to

school were evaluated through performance based rich assessment (Armstrong, 1994). Students are divided into high, middle or low PIFS profile.

Arts Propel is a five year high school arts projects piloted in Pittsburg Public Schools in Pennsylvania. There are two elements at focus: domain projects and process folio. It is a new approach to curriculum and assessment in the arts at high school level. It differs from the other approaches in terms of intellectual origins and its particular mix of components. In this approach, evaluation procedures include self-assessments and teacher assessments (Armstrong, 1994).

2.2.3 Studies Related with Gender Differences in Multiple Intelligences

There are some studies related with gender differences in academic success, attitudes toward science and multiple intelligences profiles of students. According to studies ever made, there are some differences in intelligences between male students and female students.

Synder (2000) made a research study about the learning styles, multiple intelligences and academic achievement of students. The purpose of Synder's study was to try to prepare an efficient instrument that teachers could easily administer to their classes to learn more

about the learning needs of their students. The second purpose was to study the relationship between academic achievement and the learning styles and multiple intelligences. The most obvious and the strongest result of the study pointed out the fact that this sample of high schools students, in spite of academic data and achievement test data, were primarily tactile/ kinesthetic and global learners. At the end of the study, she found that for the male students there is a positive relationship between the students' grade point average and the categories of spatial preferring working alone, self motivated visual and logical. There is a negative correlation between the students GPA and the categories of preferring

sound and preferring to work with others. For the female students, there is a positive correlation between the students GPA and the categories of global learning style, bodily-kinesthetic intelligence and tactile- kinesthetic learning style. In general, the students with stronger GPAs considered themselves to be more self-motivated, persistent and more likely to study alone.

Synder's results indicate significant gender differences regarding academic achievement and the categories of the instrument. The female students were stronger on intrapersonal, linguistic, musical, prefers working alone, visual, interpersonal, self motivated prefers quiet, GPA, analytical and persistence. The male students were stronger on bodily kinesthetic, logical, spatial and working with others.

Göğebakan (2003) investigated the effect of gender and grade level of the students on their multiple intelligences in her master thesis at METU. The study was conducted at Middle East Technical University Development Foundation School in the spring of the 2001-2002 academic-years with classes of first, third, fifth and eight grade levels. She applied Pictorial Teele Inventory for Multiple Intelligences on 321 students and analyzed the results. Results of her study showed that students' multiple intelligences showed variety according to their grade levels. For example, the students at the first grade level demonstrated strong preference for linguistic intelligence and logical-mathematical intelligence in the first grade and the two intelligences were followed by spatial intelligence, and bodily kinesthetic intelligence. While the third grade students' most dominant intelligences preferences were interpersonal, spatial, logical-mathematical, and linguistic intelligence the fifth and eight grade students' preferences were interpersonal intelligence bodily-kinesthetic intelligence, musical intelligence, and spatial intelligence.

Göğebakan's and Synders' results are similar in terms of gender differences on academic success. She found that male students' logical-mathematical and bodily kinesthetic intelligence mean scores were higher than female students' whereas the female students' mean of musical intelligence score was higher than male students.

Loori (2005) investigated the differences in intelligence preferences of male and female students learning English as a second language at higher institutions in the United States of America. There were 90 international students registered at ESL centers at the three American University. The results of Loori's study showed significant differences between males' and females' preferences of intelligences. According to the results, male students preferred learning ativities involving logical and mathematical intelligence, whereas female students preferred learning activities involving intrapersonal intelligence. In addition, the most preferred intelligence was interpersonal intelligence, second was logical mathematical, the third highest was linguistic and the forth one was bodily-kinesthetic; the least preferred one was intrapersonal intelligence.

All studies related with multiple intelligences of girls and boys inform a significant gender differences on activities.

2.2.4 Benefits of Multiple Intelligences Theory

There are lots of benefits of multiple intelligences theory accepted by most educators. Armstrong believes that multiple intelligences theory can greatly affect students' behavior in the classroom by creating an environment where individuals' needs are recognized and attended to throughout the school day. Students are less likely to be confused, frustrated, or stressed out in such an environment. As a

result, behavioral" tricks" or elaborate discipline system are not needed (Armstrong, 1994)

Awakening students' multiple intelligences broadens their understanding and presents them with fresh, innovative problem-solving techniques and insights. Children develop an awareness of their strengths and discover that there is not always one way to learn (Nicholson & Nelson, 1999).

Lazear (2000) has been excited and interested with some ideas about MI. These are;

- It is easily adoptable to any topic.
- It is a very student centered model approach to learning.
- It offers a great way to use cooperative groups.
- The learning is open ended.

Armstrong maintains (1994) that by becoming familiar with the basic qualities of the eight intelligences, teachers can create an environment that will facilitate both academic and social growth. He thinks that the most charming classrooms are the ones that students are actively involved in educational practice rather than "rumblings of discontent" and the ones that supports and enhances learning.

According to Reardon (2000), a multiple intelligences approach to social skills provides an avenue for teachers to teach the skills and thinking habits necessary for students to interact with others and control their own behavior. Through role play (bodily-kinesthetic, visual-spatial) and discussion (verbal-linguistic and interpersonal), teachers and students can formulate the steps of a particular skill (logical-mathematical, verbal-linguistic) and develop internal scripts (intrapersonal) that can help students to respond less impulsively and more thoughtfully (bodily-kinesthetic, interpersonal). The use of multiple intelligences

theory in instruction and response options offers students diverse and natural ways of learning and of joining in the community. Through the use of MI, Teachers can more effectively engage young people in the governance of the classroom and can foster personal autonomy, responsibility and empowerment.

Reardon (2000) also states that a multiple intelligences approach to skills provides an avenue for teachers to teach the skills and thinking habits necessary for students to interact with others and to control their own behavior. Through role play (bodily-kinesthetic and visual) and discussion (linguistic and interpersonal), teachers and students can formulate the steps of a particular skill (logical-mathematical & verbal-linguistic) and develop scripts (intrapersonal) that can help students to respond less impulsively and more thoughtfully (bodily kinesthetic and interpersonal).

Bernstein (2001) believes that creative thinking is transdisciplinary and transferable from one field to another. More specifically, he believes that musical and scientific abilities are what we he calls “correlative talents”. By correlative talents, he means skills or abilities in several different areas that can be integrated to yield surprising and effective results. According to Bernstein, mathematics is convertible to many other forms, including visual and kinesthetic areas, as well as into music certainly most. Scientists and mathematicians of any stature in their field report a semi consciousness stream of thought composed of kinesthetic feelings, images, verbal or acoustical patterns and musical themes accompanying their problem solving.

According to talks that Campbell made with educators, multiple intelligences theory positively influences teacher beliefs in three ways: 1) the theory’s contribution to educators knowledge base and beliefs about the human

mind, 2) MI's implications of professional practice and 3) the impact of MI programs on students academic academic achievement (1991).

Hoer (2002) put forward that in an MI setting, not only are students more likely to learn and teachers more likely to bring their creativity to the fore, but other opportunities are presented as well.

Campbell (1991) clarifies that the MI offers guidance for improving learning regardless of how teachers interpret Gardner's theory. The theory describes human intelligence while also suggesting the attributes of a well-educated person with the dizzying complexities of teaching any group of students. There is great appeal in Gardner's model because it reveals both the source and the goal of intellectual development.

2.2.5 Criticims about Multiple Intelligences Theory

Besides proponents, there are also some critics of multiple intelligences theory. Traub (1998) states that most people who study intelligence, view MI rhetoric rather than science, and they are divided on the virtues of the rhetoric. They though that intelligence is not a crisp concept but a term of value indeed, the ultimate term of value. Some in Gardner's corner, like his mentor and colleague Jerome Bruner, say they wish Gardner had employed a more neutral term like "aptitude."

One of the major criticisms of the theory is that it is not precise enough. The criticism is that Gardner is not expanding the definition of the word 'intelligence'; rather, he denies the existence of intelligence, as is traditionally understood, and instead uses the word intelligence whenever other people traditionally used the word 'interest'. (Haas, 2005)

There may well be validity to Gardner's claim that core mental aptitudes are more autonomous from one another than psychometricians like to believe, but the reason psychologists don't measure the elements of "bodily kinesthetic intelligence is not that they doubt the elements exist- it's that they don't think the elements matter. (Traub, 1998)

Critiques of the theory say that:

1. It is not new. Critics of multiple intelligences theory maintain that Gardner's work isn't groundbreaking.
2. It is not well defined. Some critics wonder if the number of "intelligences" will continue to increase. These opposing theorists believe that notions such as bodily kinesthetic or musical ability represent individual aptitude or talent rather than intelligence. Critics also believe that MI theory lacks the rigor and precision of a real science. Gardner claims that it would be impossible to guarantee a definitive list of intelligences.
3. It is culturally embedded. MI theory states that one's culture plays an important role in determining the strengths and weakness of one's intelligences. Critics counter that intelligence is revealed when an individual must confront an unfamiliar task in an unfamiliar environment.
4. It defeats national standards. Wide spread adoption of multiple intelligence pedagogy would make it difficult to compare and compare and classify students' skills and abilities across classrooms.
5. It is impractical. Educators faced with overcrowded classrooms and lacks of resources see multiple intelligences theory as utopian.

Multiple Intelligences theory serves many purposes that make it powerful, but not necessarily valid (Traub, 1998).

Some people say that multiple intelligences theory is great for younger children but it won't work with high school or post secondary students. According to Lazear (2000), this error results from a lack of understanding of the developmental aspects of the intelligences. Our intelligences don't suddenly go away when we reach a certain age. They may enter various states of latency if we neglect them or if we don't continue to use them on a regular basis. High school teachers may believe that because MI is not on the tests by which students ultimately be judged, it is a waste of time. But while MI is not on the tests, if used appropriately, it can dramatically improve students' performances on tests, even when the performance required is biased toward verbal-linguistic and logical-mathematical intelligences.

2.2.6 Assessment of Multiple Intelligences

Assessment is one of the most important parts of an educational setting as it gives clues about the efficiency or effectiveness of instruction and teacher and students learning the contents or units to students, teachers, administrators, and parents. According to Gardner (1993), an assessment of a particular intelligence or a set of intelligences should be highlight problems that can be solved in the materials of that intelligence. That is mathematical assessment should present problems in mathematical settings. In his view, assessment is the obtaining information about the skills and potentials of individuals, with the dual goals of providing useful feedback to the individuals and useful data to the community. He thinks that the assessment should be a part of natural learning environment. The teachers and students should always be assessing themselves and the instruction.

Gardner (1993), in his book "The Theory in Practice" explains the assessment of multiple intelligences widely. In his view, an important aspect of assessing intelligences must include the individual's ability to solve problems or

create products using the materials of the medium. One technique for determining the individual's favored intelligences is to expose students to a complex situation that can stimulate several intelligences; or provide a set of materials drawn from different intelligences and determine toward which one an individual gravitates and how deeply he explores it. By this technique, individuals can bolster their own particular sets of intellectual weakness or combine their intellectual strengths. He proposes three important criteria for assessment:

- It should be intelligence fair.
- It should be developmentally appropriate.
- It should be linked to recommendations

According to Gardner, most testing instruments are biased in favor of two intelligences, logical mathematical and verbal-linguistic. Individuals, who are strong in these intelligences, become successful in these types of instrument. However, individuals who have problems with these domains fail in disciplines. The solution to these problems is to devise intelligence fair instruments. (Gardner, 1993)

Hoer (1994) with the Talent Community proposes five assessment strategies for MI: These are: portfolios, progress reports, profiles, genuine understanding, and standardized tests.

According to Fuini and Gray (2000), teachers can evaluate their students' learning both formally and informally. Content-oriented and outcome beach balls are great ways to gain an idea of students' understanding of content and perception of the lesson. Creating rubrics for each activity provides an objective assessment tool.

Kornhaber (1999) investigated three alternative assessments for identifying students each of which are said to draw on the theory of Multiple Intelligences. He searched answers for two questions: 1) is it reasonable to associate increases in

the identification of under-served youngsters with these assessments? 2) Is it reasonable to associate each assessment with the theory of multiple intelligences?

The three methods Kornhaber used was DISCOVER, (Discovering Intellectual Skills and Capabilities while Providing Opportunities for Varied Ethnic Responses) which consist of five activities, The problem solving Assessment (PSA) which has two phases and The Gifted Model Program. At the end of the study, Kornhaber found that the assessments helped to increase under-served students' access to more challenging curriculum.

Armstong (1994) states that all cultures in the world possess and make use of the eight intelligences in Multiple intelligences theory; however, the ways in which they do so and the manner in which individual intelligences are valued vary considerably (p123). He proposes some assessment tests related to each of eight intelligences. These are:

Verbal-linguistic: Reading tests, language tests, the verbal sections of intelligence and achievement tests.

Logical-mathematical: Mathematical achievement tests, the reasoning sections of intelligence tests.

Visual-Spatial: Visual memory and visual motor tests, art aptitude tests, some performance items on intelligence tests.

Bodily-kinesthetic: Sensory motor tests, some motor subtests in neuropsychological batteries, the president's physical fitness test.

Interpersonal: Social maturity scales, sociograms, interpersonal projective tests.

Intrapersonal: Self-concept assessments, projective tests.

Naturalist: Test items that include pictures of animals, plants or natural settings.

MI theory provides a way for all teachers to reflect on their best teaching methods and to understand why these methods work or why they work well for some students but not for other. It also helps teachers expand their current teaching repertoire to include a broader range of methods, materials, and techniques for reaching an ever wider and more diverse range of learners (Armstrong, 1994)

Armstrong (1994) utters that MI theory proposes a fundamental restructuring of the way in which educator assess their students' learning progress. He suggest a system that relies far less on formal standardized or norm-referenced tests and much more on authentic measures that are criterion- referenced, bench marked, or ipsative. In his view, the most important prerequisite to authentic assessment is observation. The next most important component in implementing authentic assessment is the documentation of student products and problem solving processing.

Chapman in his book "MI centers and Projects" describes an assessment type, projects. She maintains that projects move students to study content and apply what they learn in a way that brings about a deeper understanding of old and new knowledge. According to him, the students' ability to process and use information to produce a product makes the learning environment more relevant (1996). While studying with projects, learners use a combination of intelligences, and choose how they will present their knowledge and their ability to use information. She says:

> "MI projects are a particularly good ways to bring closure to a topic of study. Although students choose their project, which focus on different intelligences, the teacher structures the process. MI projects celebrate the many aspect of knowledge gained from studying a topic."

In summary, there should be multiple assessments if there are multiple intelligences. Gardner (1993) put an end to the assessment of intelligences. He maintains that an assessment environment should integrate curriculum and assessment and invite individuals to use their competencies by carrying out meaningful projects or activities. An assessment environment should also make available interesting and motivating materials that is sensitive to individual differences. Learning environment should be intelligence fair.

2.2.7 MI schools of the Future (teacher, student, curriculum, instruments)

Schools in the future, should be set up to make certain that the most gifted can move to the top and that the greatest number of individuals will achieve the basic knowledge as efficiently as possible. Students, teachers, administrators, school districts, states, and even the whole nation should be judged in terms of the efficiency and effectiveness with which these common standards are achieved. (Gardner, 1993)

Gardner (1993) advocates individual centered education in the light of two views. First of all, it should be accepted that individuals have different minds from one another and so education should be planned according to these differences. The second proposition is that dedicated individuals could be able to master world's extent knowledge or significant part of it.

Gardner and Blythe (1990) have sketched the dimensions of future schools. These schools should dedicate them to foster students' deep understanding core knowledge of disciplines. They should encourage students to use their knowledge to solve problems and complete the tasks. They promote student efforts on

individual projects. In the schools Gardner envisions, students study traditional subjects in untraditional ways. Almost in all areas, there should be projects.

In the future schools, the older students carry on intellectual exploration in a structured way. They spend mornings carrying out the projects of the basic core curriculum and they devote their afternoons to the apprenticeships they choose. They study intensively with master teachers in a particular area.

According to Gardner (1993), in the MI schools of the future, there should be three staff. These are;

1. Assessment specialist
2. Student curriculum broker
3. school community broker

According to Michaelis (1996), in the classroom of the future, teachers and the students work together to create an atmosphere of acceptance that celebrates different cultures, genders, intelligences, languages, gifts and talents, interests, and means of self-expression. In the school of the future, educational administrators and classroom teachers do more than just accommodate such differences; they honor and value all students.

Armstrong (1994) states some features of future classrooms. They are the schools:

- where the learning environment provides all students with easy access to tools that engage each of the seven intelligences.
- where the curriculum provides opportunities for each student to explore and develop all seven intelligences

- where the faculty use the seven intelligences as tools of instruction

- where students work together in multi-age and multi-ability groupings.

Hoer (2002) reported that parent education, something which should be highly valued in any school, becomes a major priority in an MI school. Because none of the students' parents will have attended an MI school, educators need to help them understand how the intelligences are used and that their children are learning. By creating an environment in which more talent are recognized and in which more children can succeed, students will naturally approach school with more enthusiasm and interest.

2.3 Chemical Bonding

Students struggle to understand chemical bonding concept as it is an abstract concept. In Turkey, students are introduced that topic in 8th grade science courses. They learn the types of intramolecular bonds; covalent and ionic only. In high school, students are introduced intermolecular bonds besides intramolecular. They have difficulty in understanding intermolecular bonds especially weak Van der Waals bonds. In the other countries, the bond concept is shown to the students in grade level twelwe.

In many ways, the study of chemistry is the study of the molecule (Hurst, 2002). As Hurst clarified, chemistry is the study of matter which composed of the tiny particles called atoms and molecules. All chemical studies were based on these particles. They constitute the corner stone of chemistry. There are huge numbers of these particles in all substances. Then, what is the means of getting these particles together? Certainly, the answer is chemical bonds. In this part, the chemical bonds between these smallest particles will be explained.

Peterson, Treagust, and Garnett (1986) reported that the specific difficulties students have with respect to chemical bonds by, who noted among other things

that students at grades 11 and 12 held the misconception that intramolecular covalent bonds instead of intermolecular bonds are broken when a substance changes phase. Also, Kiokaew (1989) informed that Year 1 university students also held misconceptions about the difference in nature between intra- and intermolecular bonds (Boo, 1998). Taber found that students used to representing bonds as lines in fixed positions, may not recognize other representations as showing bonds. (Taber. 2004)

Coll and Treagust (2003) investigated the mantal models of bonding of secondary, undergraduate, and graduate level students. According to their findings, the secondary school learners see ionic bonding as consisting of attraction of oppositely charged species that arise from the transfer of electrons driven by the desire of atoms to obtain an octet of electrons. The undergraduates see the lattice structure as a key component of ionic substances and identify specific ionic lattices for the physical prompts used as probes. They also found that the graduate students identified strongly with ionic lattices, were less likely to focus on particular ionic structures, and had a stronger appreciation for the notion of the ionic-covalent continuum.

Boo (1998) investigated 48 students understanding of bonds and energy. He reported that a large number of students see chemical bonds as a physical entity and they thought that bond making requires input of energy and bond breaking releases energy. Some students in his study saw the ionic bond as the result of sharing of electrons and covalent bond as the result of transference of electrons.

Nicol (2001) explored the undergraduate chemistry students about chemical bonding. He examined the different topics in chemistry. At the end of the study, he

found that students confuse ionic and covalent bonding polarity of the molecules, atoms and molecules, reason of boding, and octet rule.

Harrison and Treagust investigated (2000) the students' understanding of multiple models used to explain upper secondary chemistry concepts. He searched the question if it can be increased. His study qualitatively tracked ten students' modeling experiences, intellectual development, and conceptual status throughout grade 11 as they learned about atoms, molecules, and chemical bonds. The results of their study suggests that students who socially negotiated the shared and unshared attributes of common analogical models for atoms, molecules, and chemical bonds, used these models more consistently in their explanations. Also, students who were encouraged to use multiple particle models displayed more scientific understandings of particles and their interactions than did students who concentrated on a "correct" or best analogical model. The results suggest that, when analogical models are presented in a systematic way and capable students are given ample opportunity to explore model meaning and use, their understanding of abstract concepts is enhanced.

All studies related with the chemical bonding and reactions revealed that many students between the ages 12 and 18, thought that atoms vary in shapes e.g. square, rectangular (Coll, Treagust, 2003). The students are in difficulty with the interactions of atoms and molecules.

Multiple intelligences theory can be used to eliminate these misunderstandings. By amusing the students, the lesson can be learned effectively. By using multiple intelligences theory, students' attention can be held maximum. By this way, learning difficulties can be removed. For example, for the students with high spatial intelligence, showing models of molecules is a good way to shape the bonds in students' mind. For the students with high linguistic ability,

the differences between the chemical bonds in molecules can be explained. This concept can be taught to students with high kinesthetic intelligence by the help of role playing, games etc…

2.4 Students' Attitudes toward Science

A better understanding of student achievement and persistence in science may be found in investigating the causal relationships between student's attitudes toward science and their achievement in science over time (Mattern, Schau, 2002).

From the literature, it can be inferred that attitude is one of the predictor of success. It can be said that a child can be successful if it has positive attitude toward science. Kahle and Lakes (2003) search the equality and the attitudes of female and male students in science classrooms. They concluded that the female students displayed negative attitudes toward science and careers. Kelly (1981) also found that the girls in single sex schools have better attitudes toward science than those in coeducational schools (Kahle&Lakes, 2003). According to their results, there are two factors effecting the girls's enrollments and achievements in science, educational and attitudinal factors. One educational factor is the unequal science training. The number of scientific activities for boys exceeds that for girl in every area including science observations, instrument skills, field trips, experimental tasks, and extracurricular activities. Another factor is that girls found their science class as boring and not particularly useful. A second factor limiting girls in participating science is sex stereotyped careers (Vockell & Lobonc, 1981).

Salta and Tzougraki (2004) search the attitudes of 11^{th} grade students in Greece about chemistry. They tried to find answers to the
questions below;

- Are there gender differences in students' attitudes toward chemistry?

- Are there differences between students with different study specialization in their attitudes toward chemistry?
- Is there significant correlation between students' attitudes toward chemistry and their achievement in chemistry?

At the end of the study, they found that there was no significant difference in the level of interest, usefulness, and importance attributed to chemistry between boys and girls. Nevertheless, girls held a significantly less positive attitude than boys regarding the difficulty of chemistry courses. Their results also indicate the outcomes below:

• The students specializing in science-medicine held significantly more positive attitude regarding the four variables than students specializing in the other studies.

• The students specializing in humanities held significantly less positive attitude regarding the difficulty, interest, and usefulness attributed to chemistry than students specializing in engineering studies. However, there was no significant difference in attitude regarding the importance of chemistry by students specializing in humanities and engineering studies.

They did not found a significant positive correlation between the students attitudes toward chemistry and their success. However, they found a strong correlation between the success and perceieved difficulty of course.

There are lots of studies related with the attitudes of students toward science and gender differences in attitudes. There is one common point in these studies. They found that attitude toward science effects the achievement. Also, in this study, the same result has been found. When, it is overlooked in the view of gender, it can be inferred that girls attitude toward science is negative compared to boys.

CHAPTER III

PROBLEMS, HYPOTHESIS and METHODS

In this chapter, the main problems, related sub-problems and hypothesis will be presented.

3.1 The Main Problem and the Sub-Problems

3.1.1 The Main Problem of the Study

The main purpose of the study is to examine the effectiveness of multiple intelligences theory based instruction (MITBI) over Traditional Science Instruction (TSI) on 9^{th} grade students' achievement in chemical bonding concepts and their attitudes toward chemistry.

3.1.2 The Sub-Problems

Sub-problems of the study are indicated below:

1. Is there a significant difference between the effects of multiple intelligences based instruction (MITBI) and traditional science instruction (TSI) on 9^{th} grade students' achievement in chemical bonding concepts when their science process skills are controlled as a covariate?

2. Is there a significant difference between the performances of males and females with respect to achievement of chemical bonding concepts, when their science process skills are controlled?

3. Is there a significant effect of interaction between treatment and gender differences on students' achievement of chemical bonding concepts?

4. What is the contribution of students' science process skills to their achievement of chemical bonding concepts?

5. Is there a significant difference between the effects of multiple intelligences based instruction (MITBI) and traditional science instruction (TSI) with respect to attitudes of students toward chemistry?

6) Is there a significant difference between the attitudes of male and female students toward chemistry?

3.2 Hypothesis

In the study following hypothesis were developed to find solutions to main problems and sub problems stated above. All hypotheses were stated as null hypothesis.

$H_0$1: There is no significant difference between post-test mean scores of the students instructed with multiple intelligences theory based instruction (MITBI) and those instructed with traditional science instruction (TSI) with respect to achievement of chemical bonding concepts when their science process skills are controlled as a covariate.

$H_0$2: There is no significant difference between the post-test mean scores of males and those of females with respect to their achievement of chemical bonding concepts when their science process skills are controlled.

$H_0$3: There is no significant effect of interaction between treatment and gender difference on students' achievement of chemical bonding concepts.

$H_0$4: There is no significant contribution of students' science process skills to their achievement of chemical bonding concepts.

$H_0$5: There is no significant mean difference between post-test mean scores of the students instructed with multiple intelligences theory
based instruction (MITBI) and those instructed with traditional science instruction (TSI) with respect to their attitudes toward chemistry.

$H_0$6: There is no significant difference between post-test mean scores of females and males in terms of their attitudes toward chemistry.

CHAPTER IV

DESIGN OF THE STUDY

In this study, the quasi-experimental design was used (Gay, 1997). Students were randomly assigned to treatment and control groups. The design of the study is given in table 4.1 below.

4.1 The Experimental Design

The design of the study is given in Table 4.1

Table 4.1. Research Design of the Study

Groups	Pretest	Treatment	Posttest
EG	CBAT ASTC SPST	MITBI	CBAT ASTC
CG	CBAT ASTC SPST	TSI	CBAT ASTC

In the table, EG represents Experimental Group instructed with multiple intelligences theory. CG represents the Control Group receiving traditional science instruction. CBAT is chemical bonding achievement test and ASTC is attitude scale toward chemistry. CBAT and ASTC were applied twice to each group as pre and post tests. SPST in the table represents the Science Process Skill Test. MITBI is Multiple Intelligences Theory based instruction and TSI is the traditional science instruction.

To examine the students' previous knowledge in chemical bonding concepts and their attitudes toward chemistry, two tests which were CBAT and ASTC were administered to both group students at the beginning of the instruction. At the end of the treatment, these two tests and SPST were administered to both groups again.

4.2 Subjects of the Study

The target population of the study was all ninth grade public schools in Keçiören district. The accessible population was determined as all ninth grades students in Genç Osman High school in Keçiören. There were two chemistry teachers in this school. In the study, 50 ninth grade students from two classes of science course instructed by the same teacher from Genç Osman High School took part in. The results were generalized to this population.

This study was conducted during Second semester of 2005. It has been lasted for three weeks. The students in experimental and control group were assigned randomly to the groups. The experimental and control groups both consists of 25 individuals.

In this district, the students have low socio-economic status. Their families' incomes are low. The education level of the parents is low. Their fathers are generally secondary or high school graduates, whereas their mothers are primary school graduates or they are housewifes.

4.3 Variables

In the study, two types of variables were involved. These are the dependent, independent variables. Independent variables are the ones that the researcher chose for they could be manipulated to prevent their possible effects on one or more other variables. The variable which is called as dependent variable is influenced by independent variables.

4.3.1 Independent Variables

The independent variable in this study was treatment; Multiple Intelligences Theory Based Instruction versus Traditional Science Instruction, gender and science process skill.

4.3.2 Dependent Variables

In this study, dependent variables were the students' achievement of chemical bonding measured by achievement test, their attitudes toward chemistry measured by attitude scale.

4.4 Instruments

4.4.1 Chemical Bonding Achievement Test (CBAT)

This test is developed by the researcher. In this part of the study, there are 25 multiple choice questions two of which were taken from university entrance examination, twenty of the items were constituded by the researcher, and three of them were prepared parallel with university entrance examinations (see Appendix B). The content was mainly prepared according to ninth grade curriculum and instructional objectives. Also, other texts books were used. There are five alternatives in each question of multiple choice tests one of which is the correct answer and the other are the distracter. The items used in the test are related with the chemical bonding concepts: the main purpose of bond forming, examples of matters in which bonds are present from the natural world, intra and intermolecular bonds, properties of bond types, ionic and moleculer compounds, Levis structures of molecules, orbital diagrams of elements and compounds, the relation between element and bond type it formed. As the school language was Turkish, Turkish was used in the lesson plans, activity sheets, and homeworks.

During the developmental stage of the test, the procedure written below was administered. First, the PREACH and PREATT tests were applied in order to determine the prior knowledge about chemical bonding concepts and attitudes of students toward chemistry. The content validity of the study was examined by three chemistry teachers, one researcher and one university professor. The treatment which is multiple intelligences theory based instruction was applied to the two ninth grade classess of Genç Osman High School. At the end, the effectiveness of the two methods was compared. The reliability of achievement test was found to be 0, 55 with the Cronbach alpha estimates of internal consistency. This low result of reliability can be arised from not conducting a pilot study before the treatment. Probably, the questions were difficult for the students, the student's educational levels were low, and they were in bias in the negative questions.

4.4.2 Attitude Scale toward Chemistry (ASTC)

An attitude scale developed by Geban, Ertepınar, Yılmaz, Altın and Şahbaz (1994) to measure students' attitudes toward chemistry as a school subject was used (see Appendix C). This instrument consisted of 15 items in 5 point likert type scale (fully agree, agree undecided, partially agree, fully disagree). Its language is Turkish. The reliability was found to be 0.83. This test was administered to all students in both groups as a pre-test and post-test.

4.4.3. Science Process Skill Test (SPST)

This test was originally developed by Okey, Wise and Burns (1982). It was translated and adapted into Turkish by Geban, Aşkar and Özkan (1992). This instrument consists of 36 four-alternative multiple choice questions. It includes five subsets designed to measure the different aspects of science process skills. These

are intellectual abilities of students related to identifying variables, identifying and stating the hypotheses, operationally defining, designing investigations and graphing and interpreting data. It was given to all students in the study. The reliability coeficient of the test was found to be 0.85. (see Appendix D). The reason for administering science process skill test (SPST) was to determine whether there was a contribution of students' science process skills to their achievement of chemical bonds of chemistry course. The test was given at the end of the study to both groups (see Appendix D).

4.5. Treatment

This study was conducted approximately three weeks during the 2004-2005 spring semesters at Ankara Genç Osman Public School. 50 9^{th} grade students, 27 of which was male and 23 of them was female from two classes of the chemistry course of the same teacher were involved in the study.

There were two goups in the study which are assigned as the experimental group and the control group. Experimental group students were instructed with multiple intelligences based instruction whereas the control group was administered by traditional science instruction. Students in both experimental group and control group had the same conditions. That is, the instructional methods were randomly assigned to the classes, the instructor of the both two groups were same and the students in two groups were exposed to same content, i.e, chemical bonding unit of the chemistry course for the same duration, three weeks. The classroom instruction of the groups was regularly scheduled as three times per week in which each teaching session lasted 40 minutes. The topics related with chemical bonding concept were covered as a part of the regular curriculum.

The teacher was trained about the implementation of the multiple intelligences based instruction and the profiles of intelligences before the treatment. In order to verify the treatment, the researcher observed instructions in both groups randomly.

This study was conducted using a pre-test and post-test control group design (Campbell & Stanley, 1966) with chemical bonding achievement test and attitude scale toward chemistry, which was distributed to measure students' attitudes toward chemistry. Morever, at the end of the treatment all students in the study received Science Process Skill Test to assess their science process skills.

At the beginning of class schedule, achievment test, attitude scale and science process skills test were applied to both classrooms. After the duration has finished the researcher applied the tests again.

In the control group, traditionally designed instruction was administered as a regular chemistry courses. The students were instructed with traditionally designed chemistry texts. During the classroom instruction, the teacher used lecture method to teach science subjects. She explained the topic, sometimes asked questions and solved problems related with the topic. She walked around the room during the lesson, answered some questions and made suggestions when needed. The class sometimes discussed the topic.

Student in the experimental group were instructed with multiple intelligences theory. Lesson plan samples were placed in the appendix E. Lesson plans about chemical bonding were planned in the light of this strategy. At the beginning of the instruction, the teacher was informed about multiple intelligences theory and she was given the information about how to apply the lesson plans and activities that the researcher prapared in three hour sessions. The teacher divided the classroom into five groups with five students at the beginning of the instruction.

So the interaction of the students is increased by the help of cooperative learning strategy for interpersonal students.

There were two parts in this study consisting of concepts and principles in chapter “Structure of the Matter”. The concepts studied with both experimental and control group are as follows:

1. Intramolecular Bonds
    i. Ionic Bonds
    ii. Covalent bonds
    iii. Lewis structure
2. Intermolecular bonds
    i. ionic bonds
    ii. metallic bonds
    iii. Van der waals
    iv. Hydrogen bonds
    v. Dipole-dipole
    vi. Network covalent bonds
3. Types of compounds
    i. ionic compounds
    ii. molecular compounds

Lesson plans are planned by taking care of the eight types of intelligences. Computer, projector, worksheets, colored activity papers, role playing, discussion, interpretations are made to reveal students dominant intelligences and promote hidden ones. There is a sample of one lesson instructed with multiple intelligences theory in the following.

The first lesson begins with the questions:

- What do we know about the chemical bonds?
- What do we know about the types of bonds?
- Can you give examples to chemical bonds from everyday life?

This method is used for the students with verbal linguistic and naturalist intelligences to be aware of the chemical bonding concept and to activate them to participate actively in the lesson. This method can also be used to motivate all students to be aware of the lesson.

After a short discussion about chemical bonds, the teacher divided the class into five groups, each of which includes five students. This tactics was thought to be effective for the interpersonal learners. By the help of group work, the interpersonal intelligences of these students were expected to develop. Then, she said class to find a group name and choose a leader. The researcher hoped that the group will choose the person who has the highest verbal linguistic and interpersonal intelligences. After that, she gave the activity 1 to each group. She distributed the questions written to colored A4 paper and answers written on post-it. It is expected that the visual learners will be affected with the colors. Then, she asked students to find the suitable answer to each question and attach it to the question paper with their group member. She said the group which finished first would be given the present. She asked the group leaders to read the answers. After that, the class discussed the questions.

Following that activity, as an example to the ionic bonds, the teacher showed the animation of the formation of NaCl compound with the help of the projection apparatus and asked students to interpret the reaction step by step. This activity would evoke admiration of visual learners. Then, she asked the groups to write a paragraph about the formation of NaCl compound and distributed the

worksheet one for individual study. Then she made some students read their comment about the bonding of Sodium with Chlorine.

At the end of the treatment, the researcher applied the achievement test, chemistry attitude scale and science process skill tests.

4.6 Analysis of Data

In this study, t-test and Analysis of Covariance (ANCOVA) was used to compare the effectiveness of two different instructional methods related to chemical bonding concept by controlling the effect of students' science process skills as covariate. Also this statistical technique identified the contribution of science process skills to in achievement. In addition to ANCOVA, independent t-test was used to compare the effect of treatment on students' attitudes toward chemistry as a school subject.

4.7 Assumptions and Limitations

There are some assumptions and limitations encountered during the study. They are listed below:

4.7.1 Assumptions:

1. Students in experimental group did not interact with students in control group.

2. The teacher who applied the treatment was not biased.

3. The tests were administered under standard conditions.

4. All students gave accurate and sincere responses to all items in the instruments used in the study.

4.7.2 Limitations:

There were some limitations of the study:

1. The subjects of the study were limited to 9th grade students of Genç Osman Public School in Ankara.

2. The study was limited to the unit of “Chemical bonding” concept.

3. This study was limited to 50 students in two classes of Genç Osman Public School.

4. Duration of the study was limited. It took only three weeks and 2 hours each week.

5. The media of the learning environment was not available. The researcher supplied most of the materials required such as computer, laboratory instruments, and projector.

6. The assessment type was multiple choice test which is not for all students, only for number smart students.

7. A pilot study for the chemical bonding achievement test and the MI based instruction was not conducted.

CHAPTER V

RESULTS AND CONCLUSIONS

5.1 Results

5.1.1. Statistical Analysis

The hypothesis stated in chapter 3 were tested at $\alpha = 0.05$ significance level. Analysis of covariance and independent samples T Test were used to test the hypothesis. The statistical analyses were carried out with SPSS/PC (Statistical Package for Social Sciences for Personal Computers) (Noruis, 1991).

The analysis showed that there was no significance at mean scores at the beginning of the treatment between the multiple intelligences theory based instruction (MIBI) group and traditional science instruction (TSI) group in terms of students' achievement of chemical bonding concept ($t=8.31$, $df=48$, $p>0.05$) and students' attitudes toward chemistry ($t=2.98$, $df=48$, $p>0.05$) and their science process skills ($t=3.16$, $df=48$, $p>0.05$).

Hypothesis 1:

To answer the question posed by hypothesis 1 stating that there is no significant difference between the post-test mean scores of the students instructed with multiple intelligences theory and those instructed with traditional science instruction with respect to achievement of chemical bonding concept when science process skill is controlled as a covariate, analysis of covariance (ANCOVA) was used. The results obtained are shown in Table 5.1.

Table 5.1. ANCOVA Summary (Achievement)

Source	df	SS	MS	F	P
Covariate (Science Process Skills)	1	11.67	11.67	2.358	0.132
Treatment	1	233.1	233.1	47.09	0.000
Gender	1	1.160	1.160	0.234	0.631
Treatment*Gender	1	0.618	0.618	0.125	0.726
Error	45	222.753	4.95		

The results showed that post-test mean scores of MITBI group and TSI group in terms of achievement related to chemical bonding concept were significantly different. Mean scores of the two groups are shown in Table5.2.

Table 5.2 Mean Scores of the Groups

	CLASS	N	Mean	Std. Deviation	Std. Error Mean
POSTACH	1	25	16.44	1.80	.36
	2	25	11.20	2.58	.52

MIBI group scored significantly higher than the TSI group (X (MIBI) = 16.44, X (TSI) = 11.20).

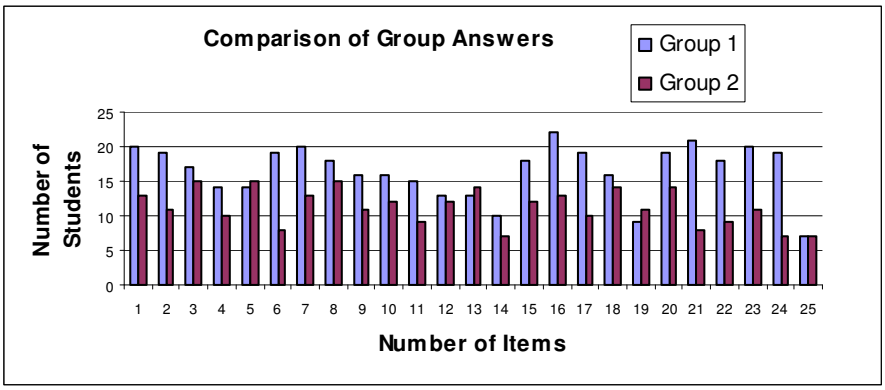

Figure 1: Comparison of Group Answers of the two groups

By looking at the results of the chemical bonding achievement test given as a pretest and post test to experimental and control groups, the percentage achievement of student was found %59.5 for experimental group and %40.5 for control group. Mean of the group 1 is 16.4 and that of group 2 is 11.2.

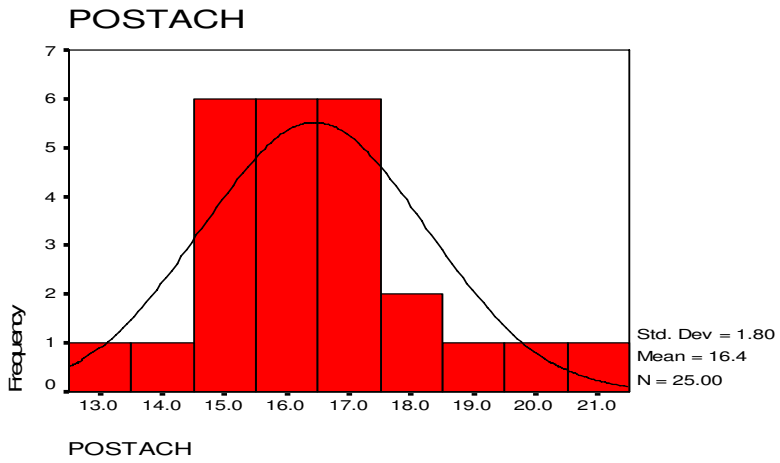

Figure 2: Post achievement Scores of Group 1(Experimental Group)

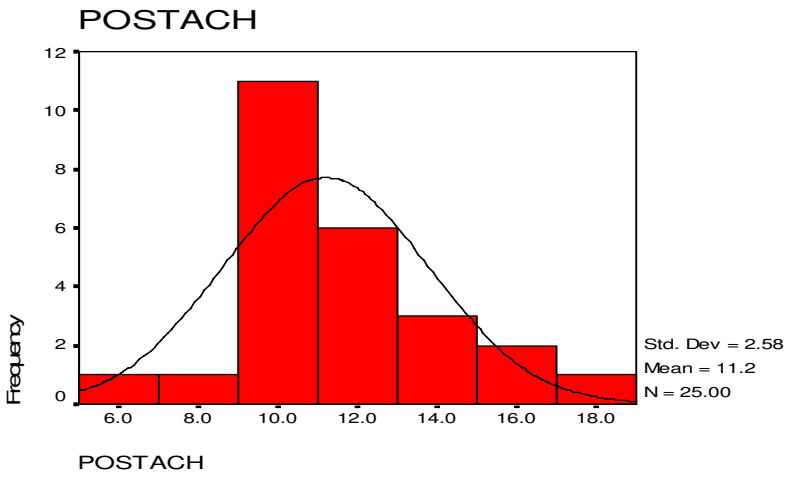

Figure 3: Post Achievement Scores of Group 2 (Control Group)

Hypothesis 2:

To answer the question posed by the hypothesis 2 stating that there is no significant difference between the post tests mean scores of males and that of females, analysis of covariance was used. The results were shown in Table 5.1. According to the table, as it is seen, there was no statistically significant difference between the mean scores of males and females with respect to chemical bonding concept. (F=0.234, P=0.631). Mean scores of females is 45.6 % and that of males is 54.4 %.

Table 5.3 % Total Sum of females and males

POSTACH * GENDER

GENDER	Mean	N	Std. Deviation	Median	% of Total Sum
1	14.32	22	3.54	15.00	45.6%
2	13.43	28	3.38	14.50	54.4%
Total	13.82	50	3.44	15.00	100.0%

Hypothesis 3:

To answer the question posed by hypothesis 3 stating that there is no significant effect of interaction between treatment and gender with respect to achievement of chemical bonding concept, analysis of covariance was used. The results in Table 5.1 indicated that there was no significant effect of interaction between treatment and gender on achievement of chemical bonding concept (F=0.125, P=0.726).

Hypothesis 4:

To asnswer the question posed by hypothesis 4 stating that there is no significant contribution of students' science process skils to their achievement on chemical bonding concept, analysis of covariance was used. The results in Table 5.1 showed that student's science process skills had no significant contribution to the variance in their achievement. From the correlation measurement, it has 2% percent effect on achievement.

Hypothesis 5:

To answer the question posed by the hypothesis 5 stating that there is no significant difference between post-test mean scores of the students instructed with multiple intelligences based instruction (MIBI) and those taught with the traditional science instruction (TSI) with respect to chemistry as a school subject, t-test was used. The results were shown in Table 5.4.

Table 5.4 The Analysis of Data for Group Comparison with Respect to Attitude Scale toward Chemistry (ASTC) results.

Group	n	X	s	df	t	p
MIBI	25	58.04	8.32			
TSI	25	51.40	7.35	48	2.989	0.004

The results showed that there was a significant difference between the post-test mean scores of the students instructed with multiple intelligences based instruction (MIBI) and that of students taught with traditional science instruction (TSI) with respect to attitudes toward chemistry as a school subject.

Hypothesis 6:

To answer the question posed by hypothesis 6 stating that there is no significant difference between post-test mean scores of females and males in terms of their attitudes toward chemistry, t-test was used. The results were shown in Table 5.5.

Table 5.5. The Analysis of Data for Gender Comparison with Respect to Attitude Scale toward Chemistry Results

Gender	n	X	s	df	t	p
1	22	55.64	6.90			
2	28	54.00	9.58	48	0.675	0.503

The results indicated no significant mean difference between the post test mean scores of the males and that of females with respect to attitudes toward chemistry.

5.1.2 Observations of Students

Students in the experimental group were observed during the whole study. The students in the group did the activities and experiments enthusiastically. They understand how to do laboratory experiments and identified the equipments. They discussed their findings with their groups. They interpreted the activities which require comment. Some of the students searched and brought another sources to the class. Class schedules were enjoyable to the students.

5.2 Conclusions

The following conclusions can be inferred from the results of this study.

1. The multiple intelligences based instruction (MIBI) caused a significantly better result in the achievement of chemical bonding concept than the traditional Science Instruction (TSI).

2. Science process skills were not a stronger predictor for the achievement of students related to chemical bonding concept.

3. The effect of gender difference on achievement and attitude with respect to chemical bonding concept and chemistry was not statistically significant.

4. There was not a significant effect of interaction between the gender and treatment on students' achievement of chemical bonding concepts.

CHAPTER VI

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Discussion

The major purpose of this study was to compare the effectiveness of instruction based on multiple intelligences theory over traditional science instruction on ninth grade students' achievement of chemical bonding concepts and their attitudes toward chemistry.

In the view of the results obtained from statistical analysis, it can be concluded that multiple intelligences based instruction caused a significantly better understanding of chemical bonding concept. Students in the experimental group showed higher performance than the students in the control group in terms of chemical bonding concept.

Multiple intelligences theory based instrıuction was prepared according to Gardner's MI criteria. This theory states that the human intelligences can not be grouped as mathematical and linquistic and can not be evaluated with multiple choice or short answer tests. Gardner expanded the definition of intelligence. He reports the existence of eight types of intelligences named as linguistic, mathematical, visual, kinesthetic, interpersonal, intrapersonal, musical, and naturalist intelligences. In the experimental group, I tried to reveal students' hidden intelligences and strengthen the dominant ones. The activities were prepared according to eight types of intelligences. Visual materials, written documents, examples from nature, group works, verbal expressions, and, musical activities were used in order to address the intelligences of students, to activate students

with the help of their intelligences and to encourage them to improve their internal ones.

In this study, the aim was to make students active participant in the educational process. A number of studies show that students learn best when they actively participate in educational process. Saban (2002) introduced the Multiple Intelligences Theory to his classroom at Esentepe Elementary School in Konya. At Esentepe, teachers discuss their ideas, share their curricular plans, and assist one another in refining their professional practice. They tried to make students actively involved in educational practices. In this long term process, they saw that the students learn the subjects in different ways. For example, some of the students said that they understand visually, so they wanted teacher to explain the subject by drawing picture or schema.

In my study, while students were studying with their group, it is observed that some students were bored. They were a little hesitant to do group work. However, they did individual activities willingly. This shows that some some students like to do the things by themselves. Gardner calls them as intrapersonal learners. These learners produce the best products when left alone. In the study, I wanted to increase these students' interpersonal intelligence. I tried to provide students share their ideas, help and motivate each other. By group work, they would understand other people's ideas and respect to the differences in ideas.

Students were very excited when animations about the types of bonds were shown to them. They followed carefully and made comments about the animation display. They discussed the display with their group friends. Students who show great enthusiasm toward visual materials can be said to have visual spatial intelligence according to Gardners' intelligence profiles. They love and show interest to the visual materials.

According to the talks with students, some of the them found the lab schedules complex, thus boring as the time given for laboratory experiments were limited to understand the procedure and apply it. These students can be said to have low kinesthetic intelligences as they learn slower with kinesthetic movement. However, some of the students loved the lab schedules as they moved around, identified the laboratory equipments and do the experiment willingly and carefully. Dominant character of these students can be said to be kinesthetic. They love to move, touch, and do the things by hand.

For the musical learners, not many activities were designed as the time is limited and there was not much source. The teacher wanted students to write a song or a poem about the chemical bonds. Some of the students were apt to write songs or poems, and they tried to write better than the others. In Gardner's view, these students can be said to have musical intelligences. They can be motivated when science, mathematic or other disciplines can be put into the music. According to Kassell (1998), much of the multiple intelligences literature suggests exercises that link memorizing academic content with rhythms or simple songs. One reason is that music is a tool for enhancing memory. Another reason educators should be concerned is that this type of repetitive drill and practice fails to lead students to what Gardner calls "genuine or performance understandings".

Teacher in this study, did not use the multiple intelligences based instruction in traditionally designed science classroom and consider students' multiple intelligences. She explained the topic, use some worksheets related with chemical bonding, sometimes asked questions. She made students write the important points to their notebooks. Students in traditionally designed science classroom as in general, were passive listeners. They only listened the teacher,

tried to give answers to teachers if she asked questions and some took notes related with the bonds.

In this study, also science process skills of the students were analyzed. The contribution of students' science process skills to their achievement in science were investigated and found no significant contribution to the success. Students' science process skills were found to explain only % 2 of their success.

In the study, the effect of multiple intelligences based instruction to the students' attitudes toward chemistry was analyzed. It is concluded that the students in the experimental group were significantly higher, that is they loved the instruction based on multiple intelligences theory. Attitude is one of the predictor of success. It can be said that a child can be successful if it has positive attitude toward science. Kahle and Lakes (2003) search the equality and the attitudes of female and male students in science classrooms. They concluded that the female students displayed negative attitudes toward science and careers. However, in my study, there was not a significant difference between the attitudes of female students and that of male students toward chemistry.

Salta and Tzougraki (2004) search the attitudes of 11^{th} grade students in Greece about chemistry. They tried to find if there was a gender difference in students' attitudes toward chemistry, a significant correlation between students' attitudes toward chemistry and their achievement in chemistry

At the end of the study, they found that there was no significant difference in the level of interest, usefulness, and importance attributed to chemistry between boys and girls. Nevertheless, girls held a significantly less positive attitude than boys regarding the difficulty of chemistry courses. Their results are similar to the results found in this study. I found no significant difference between the attitudes of

girls and boys toward chemistry. Also they did not found a significant positive correlation between the student's attitudes toward chemistry and their success.

In this study, also gender differences were analyzed if there is a difference between the performances of males and females related to the chemical bonding and found no significant difference between the performances of males and females with respect to the achievement about the subject. This can be because of the students' similar backgrounds.

This study like the other studies related with chemical bonding concept has shown that the students have difficulty in understanding the chemical bonding concept. Students don't understand the topic as it it an abstract concept. They have difficulty in identifying the types of bonds, polarity of molecules, metallic bonds, etc. In order concepts to be more permanent, it should be standed by the visual schemas, experiments, musical activities, verbal presentations and more. The teacher should identify his studens' intelligence profiles and try to improve them in diffirent smart ways.

6.2 Implications

1. This study showed that multiple intelligences theory based instruction increases high school students academic achievement in science course and attitudes of students toward chemistry.

2. Teachers should be informed about multiple intelligences. They should be aware of their students' multiple intelligences. They should examine which activities at their students are best, which ones they like most. They should help their students maximize their potentials and intelligences.

3. For a meaningful learning, teachers should base their lessons on activities that vary according to the type of intelligences.

4. The curriculum should be designed according to the multiple

intelligences theory. There should be more time to spend on chemical bonds concept in chemistry. The curriculum should be planned according to the interests and tendency of students. Their multiple intelligences should be observed.

5. Parents also should be aware of their children's tendency and dominant character of their intelligences.

6.3 Recommendations

Based on the results of these study, following recommendations are made;

1) Similar researches may be conducted using different grade levels and different courses.

2) Other teaching methods related with multiple intelligences theory can be used in futher studies, such as problem and project based learning, discussion method, discovery learning, inquiry learning.

3) Similar studies can be conducted to evaluate the effect of multiple intelligences based instruction on reasoning abilities of students.

4) More research should be done to investigate the effect of gender on the preferences of intelligences.

5) Workshops should be conducted to enhance student's personalities.

6) The use of cooperative learning in teaching science should be encouraged.

7) Workshops should be conducted for administrators, teachers and parents to realize the effect of multiple intelligences to the achievement of science.

8) Especially for teachers, there should be in-service training to to make them aware of multiple intelligences on achievement and attitudes toward science, and gender differences of students and to train them how to develop curricular activities to enhance learners' strengths and remedy their weakness.

The least restrictive environments should be created for students in order to make it possible to develop their intelligences.

9) The least restrictive environments should be created for students in order to make it possible to develop their intelligences.

10) The same instruction can be aplied with different instructors to test the effectiveness of the different instructors on multiple intelligence based instruction.

11) The sample size can be increased for further studies to obtain more reliable results.

12) Another concepts can be choosen from chemistry for further researches such as acid- base concept or periodic table of the elements.

13) Similar studies can be conducted in different schools at the same time.

14) Future studies can be lasted for a long period of time in order to increase the effectiveness of multiple intelligences based instruction.

15) Future studies could focus on the effect of multiple intelligences theory on reading skills, leadership and critical thinking of students.

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APPENDICES

APPENDIX A

INSTRUCTIONAL OBJECTIVES

At the end of the treatment, students should,

1. name the types of chemical bonds
2. describe chemical bonds
3. explain the types of bonds
4. give examples to the bonds
5. distinguish among chemical bonds
6. apply the real life situation to the chemical bonds
7. summarize chemical bonds
8. explain how the bonds form
9. distinguish the bonds among substances
10. state electron dot structure of the atoms
11. show the Lewis Structures of elements
12. show the valence electrons of atoms around its formula
13. explain the hybridization of molecules
14. solve hybridization problems
15. calculate the number of bonds that an atom forms
16. relate bonds to the states of matter
17. listen chemistry lesson carefully
18. show awareness to the chemical bonding concept.
19. enjoy laboratory environment
20. participate class discussions
21. search another sources for the chemical bonding concept
22. set the laboratory mechanism appropriately
23. use laboratory apparatus appropriately
24. complete the laboratory procedure appropriately

APPENDIX B

KİMYASAL BAĞLAR BAŞARI TESTİ (CBAT)

Adı : ……
Soyadı : ……
Numarası : ……
Sınıfı : ……

Bu test "Maddenin Yapısı" ünitesindeki "Kimyasal Bağlar" konusu ile ilgili bulunduğunuz düzeyi belirlemek için hazırlanmıştır. Test 25 sorudan oluşmaktadır. Sınav Süresi 40 dakikadır. Soruları dikkatlice okuyarak cevaplayınız.

BAŞARILAR...

1.) Bağ oluşumunun en temel nedeni aşağıdakilerden hangisidir?

A) Elektron alışverişini sağlamak
B) Kararlı hale geçmek
C) Bileşik oluşturmak
D) Enerji açığa çıkarmak
E) Ortaklaşa elektron kullanmak

2.) Aşağıda verilenlerden hangisi iyonik bağ içerir?

A) Su B) Yemek tuzu C) Demir
D) H_2 molekülü E) Hidrojen Flüorür

3)

I. Metal ve ametal atomları arasında oluşur.
II. İyonik bağlı atomlar elektronlarını ortaklaşa kullanırlar.
III. Elektron alış verişinin olduğu bağlardır.

Yukarıdakilerden hangisi iyonik bağlar için söylenemez?

A) Yalnız I B) Yalnız II C) I ve II D) II ve III E) I, II, III

4.) Aşağıdakilerden hangisi polar kovalent bağ içerir?
(Na: 1A, Cl:7A, Rb:1A, I:7A, O:6A, H:1A, Br:7A)

A) NaCl B) RbI C) O_2 D) HCl E) KBr

5)

I. katı KNO_3 bileşiği
II. erimiş KNO_3 bileşiği
III.NaCl çözeltisi

Yukarıda verilen maddelerden hangileri elektrik akımını iletir?

A) Yalnız II B) Yalnız III C) I-II D) II-III E) I, II, III

6)

I. Ortak elektron kullanımı

II. Elektron alış verişi

III. Nötron alış verişi

Yukarıdakilerden hangileri kimyasal bağ oluşumunda meydana gelebilir?

A) Yalnız I B) Yalnız III C) I ve II D) II, III E) I, II, III

7) Bağlarla ilgili olarak aşağıdakilerden hangisi kesinlikle yanlıştır?

I. Bağ oluşurken atomlar daha az enerjili hale gelirler.

II. Bağ oluşumunda kararsızlık artar.

III. Elektron alışverişi olabilir.

A) Yalnız II B) Yalnız III C) I ve II D) II ve III E) I, II ve III

8) X_{11} ve Y_{17} elementlerinin oluşturduğu bileşiğin formülü ve bağ çeşidi aşağıdakilerin hangisinde doğru olarak verilmiştir?

A) X_2Y_3, polar kovalent bağ

B) XY, iyonik bağ

C) XY_2, Apolar kovalent bağ

D) XY, polar kovalent bağ

E) XY_2, iyonik bağ

9) Katı, sıvı ve gazların molekülleri arasındaki çekim kuvvetini gösteren büyüklük sıralaması aşağıdakilerden hangisidir?

A) Gaz<Katı<Sıvı

B) Sıvı>Gaz>Katı

C) Sıvı<Katı<Gaz

D) Gaz<Sıvı<Katı

E) Sıvı<Gaz<Katı

10) Aşağıdaki elementlerden hangisi metal bağları içermez?

A) $_{9}X$ B) $_{11}Y$ C) $_{12}Z$ D) $_{19}K$ E) $_{20}M$

11) Aşağıda verilen özelliklerden hangisi iyon yapılı bileşikler için söylenemez?

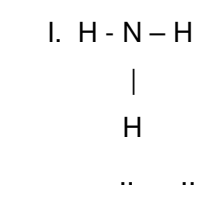
A) Sulu çözeltileri elektrik akımını iletir.
B) Oda koşullarında katı kristaller halinde bulunurlar.
C) Erime ve kaynama noktaları düşüktür.
D) Metal ve ametal arasında elektron alışverişiyle oluşur
E) Sulu çözeltilerinde + ve – yüklü iyonlar halinde bulunurlar.

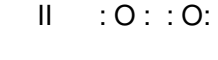
12) NaCl nin iyon yapılı bir bileşik olduğu ve sulu çözeltilerinde Na^+ ve Cl^- iyonlarının olduğu bilinmektedir.

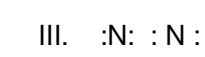
Buna göre Sodyum ve Klor atomları NaCl vermek üzere birleşirken aşağıdakilerden hangisi doğru olur?

A) Sodyum Klor arasında elektron ortaklığı kurulur.
B) Sodyum ve Klor elektron verirler.
C) Sodyum elektron verir
D) Klor elektron verir.
E) Sodyum elektron alır

13) $_1H$, $_7N$, $_8O$ atomlarından oluşan NH_3, O_2, N_2 bileşikleri için sırasıyla verilen,

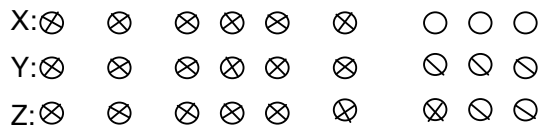
I.


II


III.


Elektron nokta şemalarından hangileri doğrudur?
A) Yalnız I B) I ve II C) I ve III D) II ve III E) I, II ve III

14) 1s 2s 2p 3s 3p



Yukarıda elektron orbital dağılımları verilen X, Y, Z elementleri için , aşağıdakilerden hangisi yanlıştır?

A) X metalik yapıdadır.
B) Z elementi elektrik akımını en iyi iletir.
C) X ve Z nin kararlı bileşiğinin formülü XZ' dir.
D) Y atomu 3 bağ yapabilir.
E) X atomunun 2 değerlik elektronu vardır.

15) Aşagıdaki niceliklerden hangisi Van der Waals kuvvetlerinin büyüklüğünü belirleyen faktörler içinde bulunmaz?

A) Moleküldeki elektron sayısı
B) Molekülün büyüklüğü
C) Molekülün biçimi
D) Molekülün ağırlığı
E) Molekül kütlesi

16) Moleküller arası bağların çekim kuvvetleri arasındaki büyüklük sıralama hangisinde doğru olarak verilmiştir?

A) Hidrojen bağı> Dipol-dipol>Van der Waals
B) Dipol-dipol>Hidrojen bağı>Van der Waals
C) Van der Waals> Hidrojen bağı>Dipol-dipol
D) Dipol-dipol>Van der Waals>Hidrojen Bağı
E) Hidrojen bağı>Van der Waals>Dipol-dipol

17) H_2O nun kaynama noktasının H_2S in kaynama noktasından yüksek olması;

I. Van der Waals bağlarının H_2O da daha kuvvetli olması
II. H_2O molekülleri arasında Hidrojen bağlarının bulunması
III. H_2S in polar olması

Verilenlerden hangileriyle ilgilidir? ($_8O$, $_{16}S$)

A) Yalnız I B)Yalnız II C) Yalnız III D) I-II E) II-III

18) Kimyasal bağlar için aşağıdaki ifadelerden hangisi yanlıştır?

A) Metaller ile ametaller arasında iyonik bağ meydana gelir.
B) Ametaller kendi aralarında elektron ortaklaşması yoluyla kovalent bağ oluştururlar.
C) Atom çapı büyüdükçe metalik bağ kuvveti artar.
D) Van der Waals kuvveti kovalent yapılı bileşiklerin moleküller arası çekim kuvvetidir.
E) Hidrojen bağları, iyonik bağlardan zayıf, Van der Waals bağlarından sağlamdır.

19) Metal bağlarıyla ilgili;

I. Atom yarıçapı büyüdükçe metal bağı kuvvetlenir.
II. İyonlaşma enerjisi büyük olan metallerin metal bağları daha kuvvetlidir.

III. Değerlik elektron sayısı fazla olan metallerin metal bağları daha zayıftır.
verilenlerden hangileri doğrudur?

A) Yalnız II B) Yalnız III C) I ve II
D) II ve III E) I, II, III

20) $_3X$, $_9Y$ ve $_7Z$ elementlerinin yaptıkları XY, Y_2 ve ZY_3 ün gaz fazındaki moleküllerinin bağları için aşağıdakilerden hangisi doğrudur?

	XY	Y_2	ZY_3
A)	iyonik	polar kovalent	polar kovalent
B)	iyonik	apolar kovalent	polar kovalent
C)	apolarkovalent	iyonik	iyonik
D)	polar kovalent	iyonik	apolarkovalent
E)	iyonik	polar kovalent	iyonik

21)Polar bir molekül için;

I.Tek cins atomlardan oluşmuştur.
II. Molekül içi bağlar polardır.
III. Farklı cins atomlardan oluşmuştur.
verilenlerden hangileri doğrudur?

A) I-II B)II-III C)I-III D)Yalnız II E)Yalnız III

22) Aşağıdakilerden hangisi elektrik akımını iletmez?
A) Sıvı gümüş B) Katı gümüş C)sulu NaCl çözeltisi
D) Sıvı NaCl E) Katı NaCl

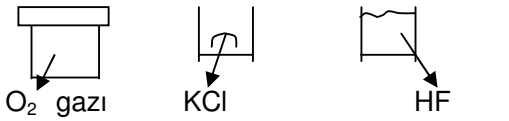
23)
I. $_{11}Na$
II. $_{12}Mg$
III. $_{17}Cl$
IV. $_{20}Ne$
Yukarıda verilen elementlerin hangileri arasında iyonik bağ oluşur ?

A) I –III ve II-IV B) I-II ve III- IV C) I- II ve I-III
D) I- III ve II-III E) I - IV ve III- IV

24) Metallerin elektrik akımını ve ısıyı iyi iletmesi aşağıdakilerden hangisiyle en iyi açıklanır?

A) Metal bağlarının bulunması
B) Erime ve kaynama noktalarının yüksek olması
C) oynak elektronların boş orbitallerde hareket etmesi
D) Tel ve levha haline gelebilmeleri
E) Elektron verme ilgilerinin yüksek oluşu

25)



I. kap II.kap III. kap

Yukarıdaki kaplardan birincisinde O_2 gazı ikincisinde KCl katısı üçüncüsünde HF sıvısı bulunmaktadır. Bu kaplarda molekül içi ve moleküller arası hangi bağ çeşitlerinin olması beklenir?

	I	II	III
A)	Polar, dipol-dipol	iyonik, dipol-dipol	apolar,dipol-dipol
B)	iyonik, hidrojen	polar, hidrojen	polar, dipol-dipol
C)	apolar, hidrojen	apolar,dipol-dipol	iyonik , hidrojen
D)	apolar,vander waals	iyonik, iyonik	polar, hidrojen
E)	metal, hidrojen	polar, vander Waals	apolar, hidrojen

Test bitti... ☺

APPENDIX C

ATTITUDE SCALE TOWARD CHEMISTRY (ASTC)

AÇIKLAMA: Bu ölçek, Kimya dersine ilşkin tutum cümleleri ile her cümlenin karşısında Tamamen Katılıyorum, Katılıyorum, Kararsızım, Katılmıyorum ve Hiç Katılmıyorum olmak üzere beş seçenek verilmiştir. Her cümleyi dikkatle okuduktan sonra kendinize uygun seçeneği işaretleyiniz.

	Tamamen katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Hiç Katılmıyorum
1. Kimya çok sevdiğim bir alandır……..	○	○	○	○	○
2. Kimya ile ilgili kitapları okumaktan hoşlanırım…..	○	○	○	○	○
3.Kimyanın günlük yaşantıda çok önemli yeri yoktur	○	○	○	○	○
4. Kimya ile ilgili ders problemlerini çözmekten hoşlanırım……	○	○	○	○	○
5. Kimya konularıyla ile ilgili daha çok şey öğrenmek isterim…….	○	○	○	○	○
6. Kimya dersine girerken sıkıntı duyarım……..	○	○	○	○	○
7. Kimya derslerine zevkle girerim…….	○	○	○	○	○
8. Kimya derslerine ayrılan ders saatinin daha fazla olmasını isterim……..	○	○	○	○	○
9. Kimya dersini çalışırken canım sıkılır…….	○	○	○	○	○
10. Kimya konularını ilgilendiren günlük olaylar hakkında daha fazla bilgi edinmek isterim……	○	○	○	○	○
11. Düşünce sistemimizi geliştirmede Kimya öğrenimi önemlidir……..	○	○	○	○	○
12. Kimya çevremizdeki doğal olayların daha iyi anlaşılmasında önemlidir……	○	○	○	○	○
13. Dersler içinde Kimya dersi sevimsiz gelir…….	○	○	○	○	○
14. Kimya konularıyla ilgili tartışmaya katılmak bana cazip gelmez……	○	○	○	○	○
15.Çalışma zamanımın önemli bir kısmını Kimya dersine ayırmak isterim……...	○	○	○	○	○

APPENDIX D

BİLİMSEL İŞLEM BECERİ TESTİ

AÇIKLAMA: Bu test, özellikle Fen ve Matematik derslerinizde ve ilerde üniversite sınavlarında karşınıza çıkabilecek karmaşık gibi görünen problemleri analiz edebilme kabiliyetinizi ortaya çıkarabilmesi açısından çok faydalıdır. Bu test içinde, problemdeki değişkenleri tanımlayabilme, hipotez kurma ve tanımlama, işlemsel açıklamalar getirebilme, problemin çözümü için gerekli incelemelerin tasarlanması, grafik çizme ve verileri yorumlayabilme kabiliyelerini ölçebilen sorular bulunmaktadır. Her soruyu okuduktan sonra kendinizce uygun seçeneği yalnızca cevap kağıdına işaretleyiniz.

1. Bir basketbol antrenörü, oyuncuların güçsüz olmasından dolayı maçları kaybettklerini düşünmektedir. Güçlerini etkileyen faktörleri araştırmaya karar verir. Antrenör, oyuncuların gücünü etkileyip etkilemediğini ölçmek için aşağıdaki değişkenlerden hangisini incelemelidir?
a. Her oyuncunun almış olduğu günlük vitamin miktarını.
b. Günlük ağırlık kaldırma çalışmalarının miktarını.
c. Günlük antreman süresini.
d. Yukarıdakilerin hepsini.

2. Arabaların verimliliğini inceleyen bir araştırma yapılmaktadır. Sınanan hipotez, benzine katılan bir katkı maddesinin arabaların verimliliğini artıdığı yolundadır. Aynı tip beş arabaya aynı miktarda benzin fakat farklı miktarlarda katkı maddesi konur. Arabalar benzinleri bitinceye kadar aynı yol üzerinde giderler. Daha sonra her arabanın aldığı mesafe kaydedilir. Bu çalışmada arabaların verimliliği nasıl ölçülür?
a. Arabaların benzinleri bitinceye kadar geçen süre ile.
b. Her arabnın gittiği mesafe ile.
c. Kullanılan benzin miktarı ile.
d. Kullanılan katkı maddesinin miktarı ile.

3. Bir araba üreticisi daha ekonomik arabalar yapmak istemektedir. Araştırmacılar arabanın litre başına alabileceği mesafeyi etkileyebilecek değşkenleri araştımaktadırlar. Aşağıdaki değişkenlerden hangisi arabanın litre başına alabileceği mesafeyi etkileyebilir?

a. Arabanın ağırlığı.

b. Motorun hacmi.

c. Arabanın rengi

d. a ve b.

4. Ali Bey, evini ısıtmak için komşularından daha çok para ödenmesinin sebeblerini merak etmektedir. Isınma giderlerini etkileyen faktörleri araştırmak için bir hipotez kurar. Aşağıdakilerden hangisi bu araştırmada sınanmaya uygun bir hipotez değildir?

a. Evin çevresindeki ağaç sayısı ne kadar az ise ısınma gideri o kadar fazladır.

b. Evde ne kadar çok pencere ve kapı varsa, ısınma gideri de o kadar fazla olur.

c. Büyük evlerin ısınma giderleri fazladır.

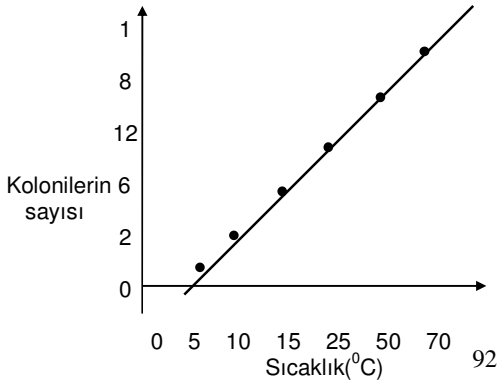
d. Isınma giderleri arttıkça ailenin daha ucuza ısınma yolları araması gerekir.

5. Fen sınıfından bir öğrenci sıcaklığın bakterilerin gelişmesi üzerindeki etkilerini araştırmaktadır. Yaptığı deney sonucunda, öğrenci aşağıdaki verileri elde etmiştir:

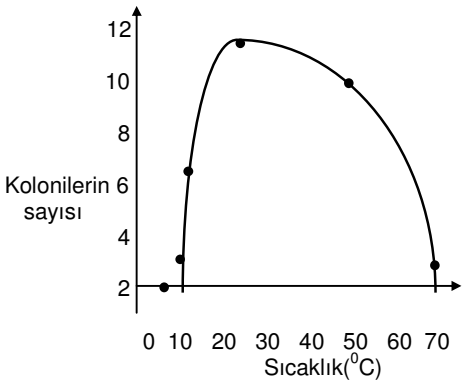
Deney odasının sıcaklığı (^{0}C)	Bakteri kolonilerinin sayısı
5	0
10	2
15	6
25	12
50	8
70	1

Aşağıdaki grafiklerden hangisi bu verileri doğru olarak göstermektedir?

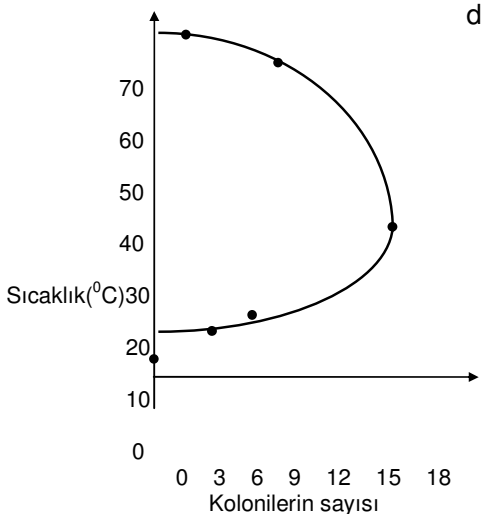
a.



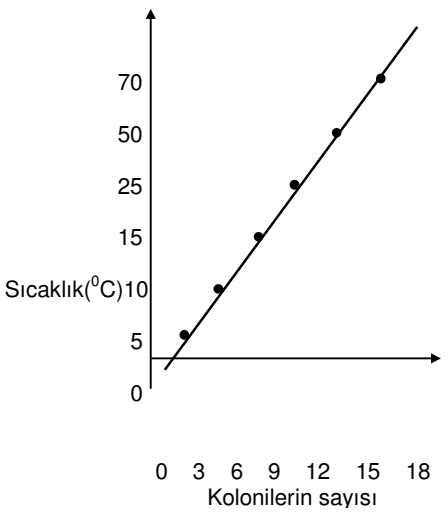
b.



c.



d.



6. Bir polis şefi, arabaların hızının azaltılması ile uğraşmaktadır. Arabaların hızını etkileyebilecek bazı faktörler olduğunu düşünmektedir. Sürücülerin ne kadar hızlı araba kullandıklarını aşağıdaki hipotezlerin hangisiyle sınayabilir?

a. Daha genç sürücülerin daha hızlı araba kullanma olasılığı yüksektir.

b. Kaza yapan arabalar ne kadar büyükse, içindeki insanların yaralanma olasılığı o kadar azdır.

c. Yollarde ne kadar çok polis ekibi olursa, kaza sayısı o kadar az olur.

d. Arabalar eskidikçe kaza yapma olasılıkları artar.

7. Bir fen sınıfında, tekerlek yüzeyi genişliğinin tekerleğin daha kolay yuvarlanması üzerine etkisi araştırılmaktadır. Br oyuncak arabaya geniş yüzeyli tekerlekler takılır, önce bir rampadan (eğiik düzlem) aşağı bırakılır ve daha sonra düz bir zemin üzerinde gitmesi sağlanır. Deney, aynı arabaya daha dar yüzeyli tekerlekler takılarak tekrarlanır. Hangi tip tekerleğin daha kolay yuvarlandığı nasıl ölçülür?

a. Her deneyde arabanın gittiği toplam mesafe ölçülür.

b. Rampanın (eğik düzlem) eğim açısı ölçülür.

c. Her iki deneyde kullanılan tekerlek tiplerinin yüzey genişlkleri ölçülür.

d. Her iki deneyin sonunda arabanın ağırlıkları ölçülür.

8. Bir çiftçi daha çok mısır üretebilmenin yollarını aramaktadır. Mısırların miktarını etkileyen faktörleri araştırmayı tasarlar. Bu amaçla aşağıdaki hipotezlerden hangisini sınayabilir?

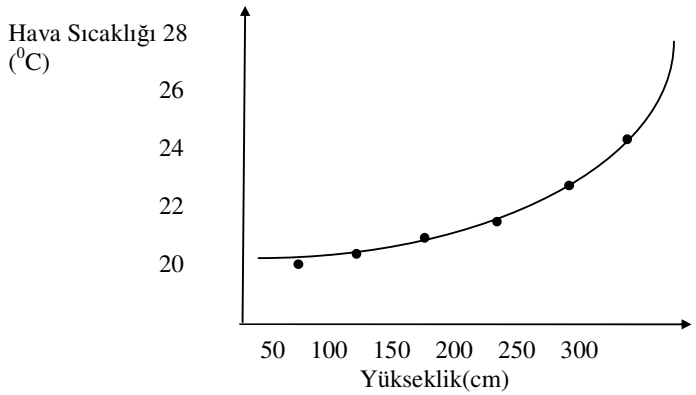
a. Tarlaya ne kadar çok gübre atılırsa, o kadar çok mısır elde edilir.

b. Ne kadar çok mısır elde edilirse, kar o kadar fazla olur.

c. Yağmur ne kadar çok yağarsa , gübrenin etkisi o kadar çok olur.

d. Mısır üretimi arttıkça, üretim maliyeti de artar.

9. Bir odanın tabandan itibaren değişik yüzeylerdeki sıcaklıklarla ilgili bir çalışma yapılmış ve elde edilen veriler aşağıdaki grafikte gösterilmiştir. Değişkenler arasındaki ilişki nedir?



a. Yükseklik arttıkça sıcaklık azalır.

b. Yükseklik arttıkça sıcaklık artar.

c. Sıcaklık arttıkça yükseklik azalır.

d. Yükseklik ile sıcaklık artışı arasında bir ilşki yoktur.

10. Ahmet, basketbol topunun içindeki hava arttıkça, topun daha yükseğe sıçracağını düşünmektedir. Bu hipotezi araştırmak için, birkaç basketbol topu alır ve içlerine farklı miktarda hava pompalar. Ahmet hipotezini nasıl sınamalıdır?

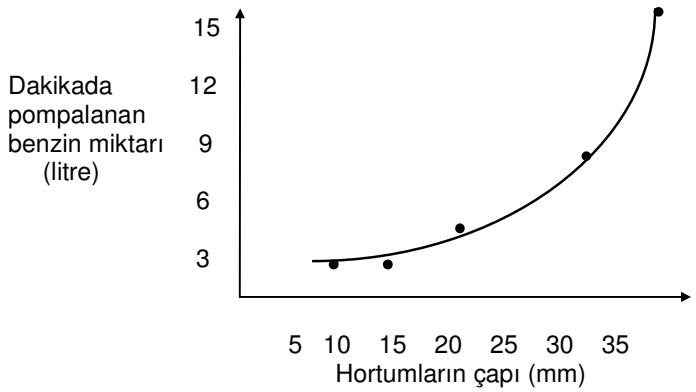
a. Topları aynı yükseklikten fakat değişik hızlarla yere vurur.

b. İçlerinde farlı miktarlarda hava olan topları, aynı yükseklikten yere bırakır.

c. İçlerinde aynı miktarlarda hava olan topları, zeminle farklı açılardan yere vurur.

d. İçlerinde aynı miktarlarda hava olan topları, farklı yüksekliklerden yere bırakır.

11. Bir tankerden benzin almak için farklı genişlikte 5 hortum kullanılmaktadır. Her hortum için aynı pompa kullanılır. Yapılan çalışma sonunda elde edilen bulgular aşağıdaki grafikte gösterilmiştir.



Aşağıdakilerden hangisi değişkenler arasındaki ilişkiyi açıklamaktadır?

a. Hortumun çapı genişledikçe dakikada pompalanan benzin miktarı da artar.

b. Dakikada pompalanan benzin miktarı arttıkça, daha fazla zaman gerekir.

c. Hortumun çapı küçüldükçe dakikada pompalanan benzin miktarı da artar.

d. Pompalanan benzin miktarı azaldıkça, hortumun çapı genişler.

Önce aşağıdaki açıklamayı okuyunuz ve daha sonra 12, 13, 14 ve 15 inci soruları açıklama kısmından sonra verilen paragrafı okuyarak cevaplayınız.

Açıklama: Bir araştırmada, bağımlı değişken birtakım faktörlere bağımlı olarak gelişim gösteren değişkendir. Bağımsız değişkenler ise bağımlı değişkene etki eden faktörlerdir. Örneğin, araştırmanın amacına göre kimya başarısı bağımlı bir değişken olarak alınabilir ve ona etki edebilecek faktör veya faktörler de bağımsız değişkenler olurlar.

Ayşe, güneşin karaları ve denizleri aynı derecede ısıtıp ısıtmadığını merak etmektedir. Bir araştırma yapmaya karar verir ve aynı büyüklükte iki kova alır. Bumlardan birini toprakla, diğerini de su ile doldurur ve aynı miktarda güneş ısısı alacak şekilde bir yere koyar. 8.00 - 18.00 saatleri arasında, her saat başı sıcaklıklarını ölçer.

12. Araştırmada aşağıdaki hipotezlerden hangisi sınanmıştır?

a. Toprak ve su ne kadar çok güneş ışığı alırlarsa, o kadar ısınırlar.

b. Toprak ve su güneş altında ne kadar fazla kalırlarsa, o kadar çok ısınırlar.

c. Güneş farklı maddelari farklı derecelerde ısıtır.

d. Günün farklı saatlerinde güneşin ısısı da farklı olur.

13. Araştırmada aşağıdaki değişkenlerden hangisi kontrol edilmiştir?
a. Kovadaki suyun cinsi.
b. Toprak ve suyun sıcaklığı.
c. Kovalara koyulan maddenin türü.
d. Herbir kovanın güneş altında kalma süresi.

14. Araştırmada bağımlı değişken hangisidir?
a. Kovadaki suyun cinsi.
b. Toprak ve suyun sıcaklığı.
c. Kovalara koyulan maddenin türü.
d. Herbir kovanın güneş altında kalma süresi.

15. Araştırmada bağımsız değişken hangisidir?
a. Kovadaki suyun cinsi.
b. Toprak ve suyun sıcaklığı.
c. Kovalara koyulan maddenin türü.
d. Herbir kovanın güneş altında kalma süresi.

16. Can, yedi ayrı bahçedeki çimenleri biçmektedir. Çim biçme makinasıyla her hafta bir bahçedeki çimenleri biçer. Çimenlerin boyu bahçelere göre farklı olup bazılarında uzun bazılarında kısadır. Çimenlerin boyları ile ilgili hipotezler kurmaya nbaşlar. Aşağıdakilerden hangisi sınanmaya uygun bir hipotezdir?
a. Hava sıcakken çim biçmek zordur.
b. Bahçeye atılan gürenin miktarı önemlidir.
c. Daha çok sulanan bahçedeki çimenler daha uzun olur.
d. Bahçe ne kadar engebeliyse çimenleri kesmekte o kadar zor olur.

17, 18, 19 ve 20 nci soruları aşağıda verilen paragrafı okuyarak cevaplayınız.

Murat, suyun sıcaklığının, su içinde çözünebilecek şeker miktarını etkileyip etkilemediğini araştırmak ister. Birbirinin aynı dört bardağın herbirine 50 şer mililitre su koyar. Bardaklardan birisine 0 ^{0}C de, diğerine de sırayla 50 ^{0}C, 75 ^{0}C ve 95 ^{0}C

sıcaklıkta su koyar. Daha sonra herbir bardağa çözünebileceği kadar şeker koyar ve karıştırır.

17. Bu araştırmada sınanan hipotez hangisidir?
a. Şeker ne kadar çok suda karıştırılırsa o kadar çok çözünür.
b. Ne kadar çok şeker çözünürse, su o kadar tatlı olur.
c. Sıcaklık ne kadar yüksek olursa, çözünen şekerin miktarı o kadar fazla olur.
d. Kullanolan suyun miktarı arttıkça sıcaklığı da artar.

18. Bu araştırmada kontrol edilebilen değişken hangisidir?
a. Her bardakta çözünen şeker miktarı.
b. Her bardağa konulan su miktarı.
c. Bardakların sayısı.
d. Suyun sıcaklığı.

19. Araştımanın bağımlı değişkeni hangisidir?
a. Her bardakta çözünen şeker miktarı.
b. Her bardağa konulan su miktarı.
c. Bardakların sayısı.
d. Suyun sıcaklığı.

20. Araştırmadaki bağımsız değişken hangisidir?
a. Her bardakta çözünen şeker miktarı.
b. Her bardağa konulan su miktarı.
c. Bardakların sayısı.
d. Suyun sıcaklığı.

21. Bir bahçıvan domates üretimini artırmak istemektedir. Değişik birkaç alana domates tohumu eker. Hipotezi, tohumlar ne kadar çok sulanırsa, o kadar çabuk filizleneceğidir. Bu hipotezi nasıl sınar?
a. Farklı miktarlarda sulanan tohumların kaç günde filizleneceğine bakar.
b. Her sulamadan bir gün sonra domates bitkisinin boyunu ölçer.
c. Farklı alnlardaki bitkilere verilen su miktarını ölçer.
d. Her alana ektiği tohum sayısına bakar.

22. Bir bahçıvan tarlasındaki kabaklarda yaprak bitleri görür. Bu bitleri yok etmek gereklidir. Kardeşi “Kling” adlı tozun en iyi böcek ilacı olduğunu söyler. Tarım uzmanları ise “Acar” adlı spreyin daha etkili olduğunu söylemektedir. Bahçıvan altı tane kabak bitkisi seçer. Üç tanesini tozla, üç tanesini de spreyle ilaçlar. Bir hafta sonra her bitkinin üzerinde kalan canlı bitleri sayar. Bu çalışmada böcek ilaçlarının etkinliği nasıl ölçülür?

a. Kullanılan toz ya da spreyin miktarı ölçülür.

b. Toz ya da spreyle ilaçlandıktan sonra bitkilerin durumları tespit edilir.

c. Her fidede oluşan kabağın ağırlığı ölçülür.

d. Bitkilerin üzerinde kalan bitler sayılır.

23. Ebru, bir alevin belli bir zaman süresi içinde meydana getireceği ısı enerjisi miktarını ölçmek ister. Bir kabın içine bir liter soğuk su koyar ve 10 dakika süreyle ısıtır. Ebru, alevin meydana getirdiği ısı enerjisini nasıl öiçer?

a. 10 dakika sonra suyun sıcaklığında meydana gelen değişmeyi kayeder.

b. 10 dakika sonra suyun hacminde meydana gelen değişmeyi ölçer.

c. 10 dakika sonra alevin sıcaklığını ölçer.

d. Bir litre suyun kaynaması için geçen zamanı ölçer.

24. Ahmet, buz parçacıklarının erime süresini etkileyen faktörleri merak etmektedir. Buz parçalarının büyüklüğü, odanın sıcaklığı ve buz parçalarının şekli gibi faktörlerin erime süresini etkileyebileceğini düşünür. Daha sonra şu hipotezi sınamaya karar verir: Buz parçalarının şekli erime süresini etkiler. Ahmet bu hipotezi sınamak için aşağıdaki deney tasarımlarının hangisini uygulamalıdır?

a. Herbiri farklı şekil ve ağırlıkta beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

b. Herbiri aynı şekilde fakat farklı ağırlıkta beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

c. Herbiri aynı ağırlıkta fakat farklı şekillerde beş buz parçası alınır. Bunlar aynı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

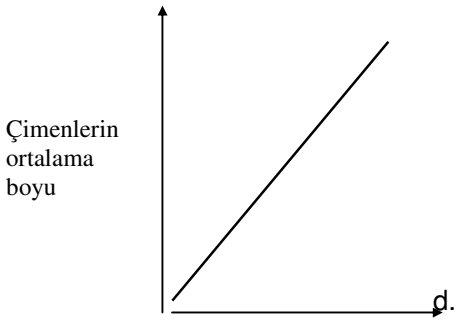
d. Herbiri aynı ağırlıkta fakat farklı şekillerde beş buz parçası alınır. Bunlar farklı sıcaklıkta benzer beş kabın içine ayrı ayrı konur ve erime süreleri izlenir.

25. Bir araştırmacı yeni bir gübreyi denemektedir. Çalışmalarını aynı büyüklükte beş tarlad yapar. Her tarlaya yeni gübresinden değişik miktarlarda karıştırır. Bir ay sonra, her tarlada yetişen çimenin ortalama boyunu ölçer. Ölçüm sonuçları aşağıdaki tabloda verilmiştir.

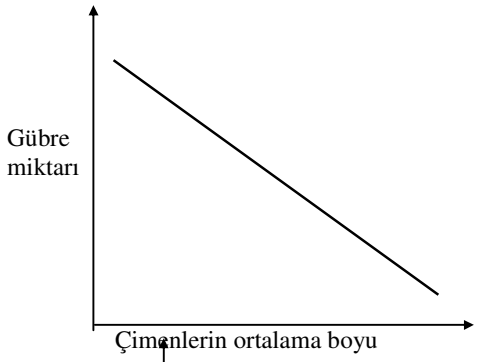
Gübre miktarı (kg)	Çimenlerin ortalama boyu (cm)
10	7
30	10
50	12
80	14
100	12

Tablodaki verilerin grafiği aşağıdakilerden hangisidir?

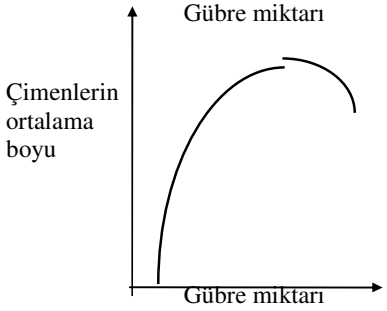
a.



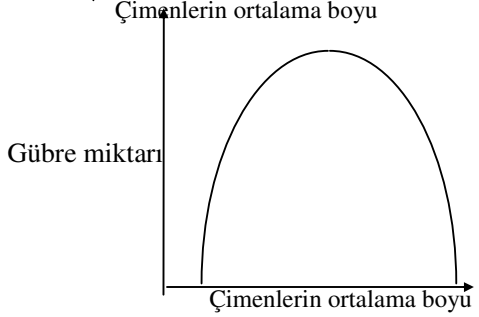
b.



c.



d.



26. Bir biyolog şu hipotezi test etmek ister: Farelere ne kadar çok vitamin verilirse o kadar hızlı büyürler. Biyolog farelerin büyüme hızını nasıl ölçebilir?

a. Farelerin hızını ölçer.

b. Farelerin, günlük uyumadan durabildikleri süreyi ölçer.

c. Hergün fareleri tartar.

d. Hergün farelerin yiyeceği vitaminleri tartar.

27. Öğrenciler, şekerin suda çözünme süresini etkileyebilecek değişkenleri düşünmektedirler. Suyun sıcaklığını, şekerin ve suyun miktarlarını değişken olarak saptarlar. Öğrenciler, şekerin suda çözünme süresini aşağıdaki hipotezlerden hangisiyle sınayabilir?

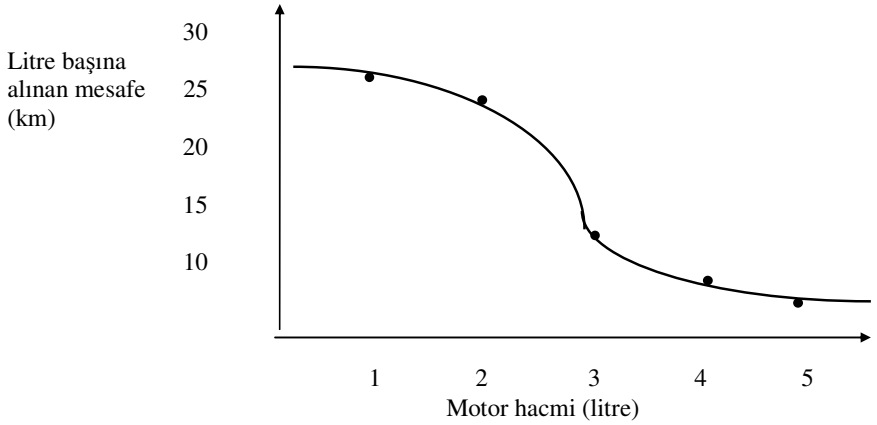
a. Daha fazla şekeri çözmek için daha fazla su gereklidir.

b. Su soğudukça, şekeri çözebilmek için daha fazl akarıştırmak gerekir.

c. Su ne kadar sıcaksa, o kadar çok şeker çözünecektir.

d. Su ısındıkça şeker daha uzun sürede çözünür.

28. Bir araştıma grubu, değişik hacimli motorları olan arabaların randımanlarını ölçer. Elde edilen sonuçların grafiği aşağıdaki gibidir:



Aşağıdakilerden hangisi değişkenler arasındaki ilişkiyi gösterir?

a. Motor ne kadar büyükse, bir litre benzinle gidilen mesafe de o kadar uzun olur.

b. Bir litre benzinle gidilen mesafe ne kadar az olursa, arabanın motoru o kadar küçük demektir.

c. Motor küçüldükçe, arabanın bir litre benzinle gidilen mesafe artar.

d. Bir litre benzinle gidilen mesafe ne kadar uzun olursa, arabanın motoru o kadar büyük demektir.

29, 30, 31 ve 32 nci soruları aşağıda verilen paragrafı okuyarak cevaplayınız.

Toprağa karıtırılan yaprakların domates üretimine etkisi araştırılmaktadır. Araştırmada dört büyük saksıya aynı miktarda ve tipte toprak konulmuştur. Fakat birinci saksıdaki torağa 15 kg., ikinciye 10 kg., üçüncüye ise 5 kg. çürümüş yaprak

karıştırılmıştır. Dördüncü saksıdaki toprağa ise hiç çürümüş yaprak karıştırılmamıştır.Daha sonra bu saksılara domates ekilmiştir. Bütün saksılar güneşe konmuş ve aynı miktarda sulanmıştır. Her saksıdan eled edilen domates tartılmış ve kaydedilmiştir.

29. Bu araştırmada sınanan hipotez hangisidir?
a. Bitkiler güneşten ne kadar çok ışık alırlarsa, o kadar fazla domates verirler.
b. Saksılar ne kadar büyük olursa, karıştırılan yaprak miktarı o kadar fazla olur.
c. Saksılar ne kadar çok sulanırsa, içlerindeki yapraklar o kadar çabuk çürür.
d. Toprağa ne kadar çok çürük yaprak karıştırılırsa, o kadar fazla domates elde edilir.

30. Bu araştırmada kontrol edilen değişken hangisidir?
a. Her saksıdan elde edilen domates miktarı
b. Saksılara karıştırılan yaprak miktarı.
c. Saksılardaki torak miktarı.
d. Çürümüş yapak karıştırılan saksı sayısı.

31. Araştırmadaki bağımlı değişken hangisidir?
a. Her saksıdan elde edilen domates miktarı
b. Saksılara karıştırılan yaprak miktarı.
c. Saksılardaki torak miktarı.
d. Çürümüş yapak karıştırılan saksı sayısı.

32. Araştırmadaki bağımsız değişken hangisidir?
a. Her saksıdan elde edilen domates miktarı
b. Saksılara karıştırılan yaprak miktarı.
c. Saksılardaki torak miktarı.
d. Çürümüş yapak karıştırılan saksı sayısı.

33. Bir öğrenci mınatısların kaldırma yeteneklerini araştırmaktadır. Çeşitli boylarda ve şekillerde birkaç mıknatıs alır ve her mıknatısın çektiği demir tozlarını tartar. Bu çalışmada mıknatısın kaldırma yeteneği nasıl tanımlanır?
a. Kullanılan mıknatısın büyüklüğü üle.

b. Demir tozlarını çeken mıknatısın ağırlığı ile.

c. Kullanılan mıknatısın şekli ile.

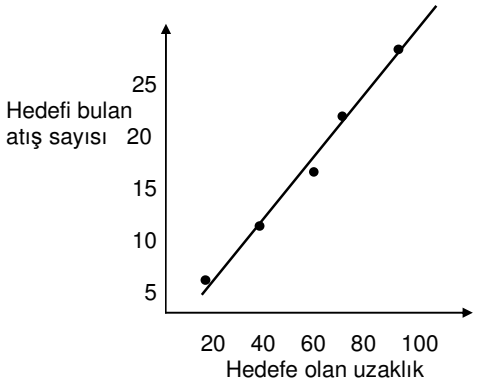
d. Çekilen demir tozlarının ağırlığı ile.

34. Bir hedefe çeşitli mesafelerden 25 er atış yapılır. Her mesafeden yapılan 25 atıştan hedefe isabet edenler aşağıdaki tabloda gösterilmiştir.

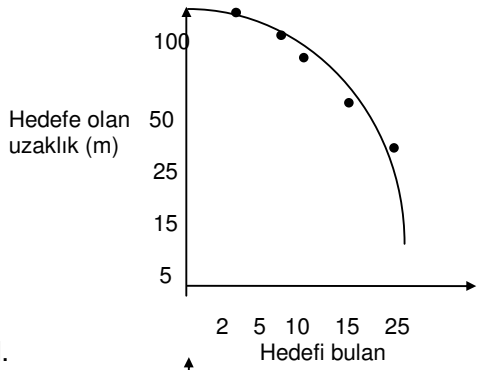
Mesafe(m)	Hedefe vuran atış sayısı
5	25
15	10
25	10
50	5
100	2

Aşağıdaki grafiklerden hangisi verilen bu verileri en iyi şekilde yansıtır?

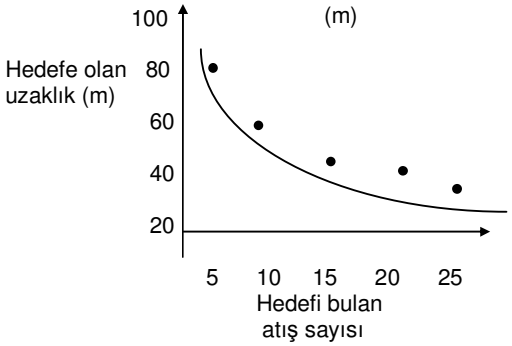
a.



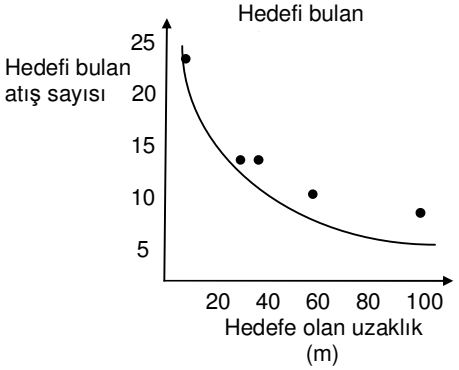
b.



c.



d.



35. Sibel, akvaryumdaki balıkların bazen çok haraketli bazen ise durgun olduklarını gözler. Balıkların hareketliliğini etkileyen faktörleri merak eder.Balıkların hareketliliğini etkileyen faktÖrleri hangi hipotezle sınayabilir?

a. Balıklara ne kadar çok yem verilirse, o kadar çok yeme ihtiyaçları vardır.

b. Balıklar ne kadar hareketli olursa o kadar çok yeme ihtiyaçları vardır.

c. Su da ne kadar çok oksijen varsa, balıklar o kadar iri olur.

d. Akvaryum ne kadar çok ışık alırsa, balıklar o kadar hareketli olur.

36. Murat Bey'in evinde birçok electrikli alet vardır. Fazla gelen elektrik faturaları dikkatini çeker. Kullanılan elektrik miktarını etkileyen faktörleri araştırmaya karar verir. Aşağıdaki değişkenlerden hangisi kullanılan elektrik enerjisi miktarını etkileyebilir?

a. TV nin açık kaldığı süre.

b. Elektrik sayacının yeri.

c. Çamaşır makinesinin kullanma sıklığı.

d. a ve c.

APPENDIX E

LESSON PLANS, ACTIVITY SHEETS AND WORKSHEETS

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLAN ÖRNEĞİ I

Ders: Kimya
Ünite: Maddenin Yapısı
Konu: Kimyasal Bağlar
Sınıf: 9
Süre: 45 dakika
İçerik taslağı:
Kimyasal bağlar
Atomları bir arada tutan kuvvetler

- - iyonik bağ

Hedef Davranışlar :

- kimyasal bağları tanımlama
- kimyasal bağlara günlük yaşamdan örnekler verme
- kimyasal bağ çeşitlerini ayırt etme
- bağ çeşitlerine örnekler verme
- iyonik bağı tanımlama
- iyonik bağa örnekler verme

Malzemeler:
Çalışma ve aktivite kağıtları, bilgisayar, projeksiyon cihazı
Hitap ettiği zeka türleri:

G*örsel-uzamsal, sözel-dilsel, matematiksel-mantıksal, öze dönük, sosyal zeka, doğa zekası.*

Dersin İşlenişi:

Bugün kimyasal bağlar konusuna geçildiğini ve bu dersin diğer derslerden farklı bir şekilde işleneceğini öğrencilere bildiriniz. Öğrencilerin ön bilgilerini ölçmek amacıyla kimyasal bağlar konusunda aşağıdaki soruları sorarak yeni konuya geçiş

yapınız (5 dak).

1) Kimyasal bağlar hakkında neler biliyoruz?
2) Kimyasal bağ çeşitleri hakkında neler biliyoruz?
3) Kimyasal bağlara günlük yaşamdan örnekler verebilir misiniz?

Bağlarla ilgili kısa bir tartışmadan sonra sınıfı 5 gruba ayırarak *Aktivite 1* i yapınız (15dak). Her gruptan kendilerine bir grup adı bulmalarını ve bir de grup temsilcisi seçmelerini isteyiniz. Renkli A4 kağıtlarına yazılı soruları ve postit lere ayrı ayrı yazılan soruların cevaplarını gruplara dağıtınız. Öğrencilerden her soruya uygun olan cevabı kitaptan veya diğer kaynaklardan faydalanarak ve grup arkadaşlarıyla yardımlaşarak en kısa sürede bulmalarını ve kağıtlara yapıştırmalarını isteyiniz. Cevapları ilk ve doğru olarak bulan gruba ödül verileceğini bildiriniz. Her grubun temsilcilerinden grubun cevaplarını okumalarını isteyiniz. Grup çalışmasından sonra soruları hep beraber tartışarak yanıtlayınız (5 dak).

İyonik bileşiklere örnek olarak NaCl' ün oluşumunu projeksiyon cihazı kullanarak gösteriniz ve öğrencilerden reaksiyonu adım adım yorumlamalarını isteyiniz (10 dak). Daha sonra *çalışma kağıdı 1* i vererek bir kimyasal bağ çeşidinin oluşumu hakkında grupça kısa bir paragraf yazmalarını isteyiniz (10 dak).

Değerlendirme: *ve Çalışma kağıdı 2* yi ev ödevi olarak veriniz.

Aktivite 1:

Sorular

1. Aynı yada farklı tür atomların bir arada tutulmasıyla..... oluşur
2. Kimyasal bağlarla birarada tutulan atomların ..... ve ..... özellikleri, kendilerini oluşturan atomlardan farklıdır.
3. .....atomlarının elektron verme, ... atomlarının elektron alma eğilimleri çok yüksektir.
4. ..... , metallerle ametaller arasında ,..... ile oluşur.
5. iyonik bağda, elektron veren metal atomu ....., elektron alan ametal atomu ise ..... yükle yüklenir.
6. İyonik bağ oluşurken, verilen elektron sayısı metalin.....sayısına, a metalin aldığı elektron sayısı ise yarı dolu..... sayısına bağlıdır.
7. İyonik bağ oluşurken atomlar daha az ..... duruma geçer.
8. Atomların değerlik elektron sayılarının simgeleri çevresinde gösterilmesine.....denir.
9. Atomlar elektron alış verişiyle .....düzenine geçmeye çalışırlar.
10. Bileşikteki değişik atom sayılarının oranlarını gösteren formüle ..... formül denir.

kimyasal bağlar	artı	kimyasal	elektron alışverişi
metal	ametal	Soy gaz	iyonik bağ
değerlik orbital	eksi	fiziksel	Basit
Levis yapısı	değerlik elektron	Enerjili	

Çalışma Kağıdı 1

Grup adı:

Merhaba arkadaşlar!

Artık hangi elementlerle hangi bağın oluştuğunu, hangi sebeplerden dolayı ve kaç farklı yolla oluştuğunu öğrendiniz. Şimdi öğretmeninizin gösterdiği animasyon için verilen aşağıdaki kelimeleri kullanarak grupça bir bağ türünün oluşumu hakkında kısa bir paragraf yazınız.

- İyonik bağ
- Metaller
- Ametaller
- Sodyum
- Klorür
- Negatif yüklü iyonlar
- Pozitif yüklü iyonlar
- Elektrostatik çekim kuvveti
- Soy gazlar

Çalışma Kağıdı 2 (Ev ödevi)

Adı:

Soyadı:

Sınıfı:

No:

Aşağıdaki soruları cevaplayınız.

1) Bağ oluşmasının temel sebebi nedir?

2) Bağ oluşurken enerji açığa çıkar. Bunun sebebi ne olabilir?

3) İyonik bağın 3 temel özelliğini yazınız.

a).....

b).....

c).....

4) Anyon ve katyon ne demektir? Açıklayınız

ÇOKLU ZEKAYA DAYALI DERS PLAN ÖRNEĞİ II

Ders: Kimya
Ünite: Maddenin Yapısı
Konu: Kimyasal Bağlar
Sınıf: 9
Süre: 45 dakika
İçerik taslağı:

- Elektron Nokta (Levis) Yapısı
- Orbital Şeması

Malzemeler: Aktivite ve çalışma kağıtları, bilgisayar, projeksiyon cihazı, animasyonlar
Hitap Ettiği Zeka Türleri: Bedensel-kinestetik, sözel-dilsel, görsel- uzamsal, matematiksel-mantıksal, öze dönük, sosyal zeka

Dersin İşlenişi:

Levis yapısıyla ilgili öğrencilerin ders kitaplarındaki tablodan da örnekler seçerek konuyu kısaca anlatınız (10 dakika). *Aktivite 2* yi sınıfı 5 gruba ayırarak yaptırınız (15 dakika).

Elementlerin orbital şemasıyla gösterimini örnekler vererek anlatınız. (10 dakika)

Çalışma kağıdı 4' ü dağıtınız ve 10 dakika içinde tablodaki boşlukları doldurmalarını isteyiniz.

Değerlendirme: *Çalışma kağıdı 4*'ü I toplayıp not verin. *Çalışma Kağıdı 3*' ü ev ödevi olarak dağıtın.

Aktivite 2

Sınıfı 5 gruba bölünüz. Atomların Levis yapısıyla ilgili olarak hazırlanan ve her birinde bir element ve atom numarası yazılı bulunan kağıtları katlayıp bir keseye koyunuz. Her gruptan birer öğrenci çağırınız ve kavanozdaki kağıtlardan çekmelerini isteyiniz. Kağıttan çıkan elementin elektron dizilişini ve Levis yapısını en önce ve doğru olarak yazan öğrenci grubuna 1 puan kazandırsın.

Bu şekilde 15 elementin Levis yapısı yazıldıktan sonra bir öğrenciye 5 kağıda yazılı olan bileşiklerdeki elementlerin atom kütlesini tahtaya yazdırın. Her gruptan birer öğrenci kura ile çeksin ve oluşumunu elektron nokta modelini kullanarak göstersinler. Grupların puanı toplansın ve birinci olan gruba ödül verilsin.

$_{11}X$	$_{12}Y$	$_{13}Z$	$_{14}T$	$_{15}K$
$_{18}B$	$_{16}L$	$_{17}M$	$_{19}C$	$_{20}D$
$_{9}E$	$_{10}A$	$_{8}P$	$_{7}R$	$_{6}S$
MgF_2	MgO	CaO	NaBr	RbI

Çalışma Kağıdı 3 (*Ev Ödevi*)

Adı:
Soyadı:
Sınıfı:
No:

1) Aşağıda verilen bileşiklerin oluşumunu Levis nokta modeliyle gösteriniz. (Na:11, Mg:12, Cl:17, Rb:37, K:19, H:1, F:9, S:16, O:8, N:7,)

a) NaCl
b) $MgCl_2$
c) RbCl
d) KCl
e) HF
f) H_2S
g) H_2O
h) NH_3

2) Yukarıda verilen moleküllerde bulunan bağ türlerini, kovalent bağlı olanların polar mı apolar mı olduğunu karşılarına yazınız.

a) NaCl……..
b) $MgCl_2$.....
c) RbCl……
d) KCl……..
e) HF……..
f) H_2S……
g) H_2O……
h) NH_3.....

Çalışma Kağıdı 4

Adı:

Soyadı:

Sınıfı:

No:

Aşağıda verilen tabloda boşlukları doldurun.

Element	Elektron Dizilişi	Elektron Nokta gösterilişi	Değerlik elektron sayısı	Grubu
$_{11}X$				
$_{16}Y$				
$_{19}Z$				

ÇOKLU ZEKAYA DAYALI DERS PLAN ÖRNEĞİ III

Ders: Kimya
Ünite: Maddenin Yapısı
Konu: Kimyasal Bağlar
Sınıf: 9
Süre: 45 dakika
İçerik Taslağı:
Kimyasal bağlar

- İyonik bağ
- Kovalent bağ

1. Apolar kovalent bağ
2. Polar kovalent bağ

Hedef Davranışlar:

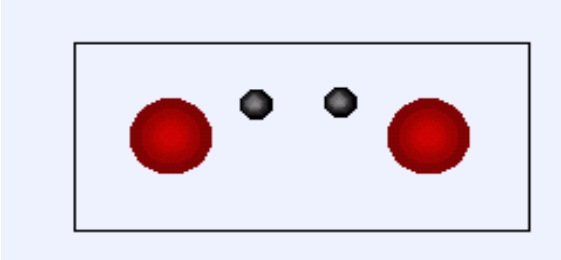
- Kovalent bağı tanımlama
- Kovalent bağa örnek verme
- Kovalent bağ türlerini tanımlama
- Bir bileşik çeşidinin polar mı apolar mı olduğunu gösterebilme
- Kovalent bağ çeşitlerine örnekler verme
- Kovalent bağla ilgili soruları çözebilme
- Kovalent bağı diğer bağlardan ayırt etme

Gerekli Malzemeler:
Aktivite ve çalışma kağıtları, bilgisayar, projeksiyon cihazı

Hitap Ettiği Zeka Türleri:
Sözel-dilsel, matematiksel-mantıksal, bedensel-kinestetik, öze dönük, sosyal, görsel zeka.

Dersin İşlenişi:
Derse, geçen derste işlenenleri kısaca anımsatarak başlayınız (5 dak).

Bilgisayar ve projeksiyon cihazı kullanarak kovalent bağlı H_2 gaz



molekülünün animasyonunu gösteriniz ve öğrencilerden yorumlamalarını isteyiniz (10 dak)

Öğrencileri 5 gruba ayırın ve aktivite 3 ü dağıtın. Rolleri paylaşmaları ve ezberlemeleri için 5 dakika süre verin. Her öğrenciye yapacakları rollerle ilgili olarak yakalarına verilen etiket yapıştırmalarını isteyin ve rolleri yapmalarında rehberlik edin (10).

İyonik ve kovalent bağlarla ilgili olan *aktivite 3* yapıldıktan sonra *çalışma kağıdı5* i dağıtınız ve 5 dakika içinde cevaplamalarını isteyiniz.

Daha sonra öğrencilere *aktivite 4* ü dağıtın ve grupça aktivite yi tamamlamaları için 10 dakika süre veriniz. Ve beraberce sonuçları tartışın.

Değerlendirme: *Çalışma kağıdı 5* i toplayıp not verin ve *Çalışma kağıdı 6* yı ev ödevi olarak dağıtın.

Aktivite 3

Arkadaşlar aşağıdaki rolleri okuyarak grup arkadaşlarınızla beraber yapmaya çalışınız.

İyonik bağ grubu:

Biri metali diğeri ametali temsil eden 2 öğrenci seçin. Bu öğrencilerden metal atomunu temsil eden öğrenci ametal atomunu temsil eden öğrenciye kalemini versin ve her ikisi de mutlu bir şekilde birbirlerine gülümsesinler, birbirleriyle kol kola girsinler ve samimi bir şekilde dolaşsınlar. Gruptan diğer iki kişi bunları birbirinden ayırmaya çalışsın fakat başarılı olamasınlar. Bu iki arkadaş aşağıdaki diyaloğu seslendirsinler:

Metal: Elektron vermeyi severim. Daha çok elektron alanlarla vakit geçiririm.

Ametal: Elektron almayı severim. Ortaklaşa da kullanırım fakat elektron verenlerle daha sıkı bağ kurarım.

Metal &Ametal:

- Önceden çok kararsızdık; fakat birbirimizi tanıdıktan sonra daha kararlı olduk.

- Bizi ayırmak zordur, artık ayrılamayız.

Kovalent bağ grubu:

Apolar Kovalent Bağ Grubu

Apolar kovalent bağı oluşturmak için ametali temsilen aynı güçte İki kız iki erkek arkadaş seçilsin. Bu öğrencilerden birinin kırmızı diğerinin siyah kalemi olsun. Öğrenciler, birbirlerinin kalemini almak için mücadele etsinler fakat güçleri

eşit olduğundan ikisi de diğerinin kalemini elde edemesinler ve kalemlerini beraber kullanmaya karar versinler.

Ametal 1: Senin kalemini istiyorum.

Ametal2 : Hayır ben seninkini istiyorum.

……..

Ametal 1: Gel en iyisi biz beraber kullanalım.

Ametal2: Tamam kabul ediyorum.

Polar Kovalent Bağ Grubu:

Bir kız bir erkek öğrenci veya bir güçlü bir zayıf öğrenci de polar bağı temsil için seçilsin. Bu öğrencilerin birer kırmızı ve siyah kalemleri olsun. Polar bağı temsil eden öğrenciler de birbirlerinin kalemine sahip olmak için mücadele etsinler ve güçlü olan diğerinin kalemini ele geçirsin. Bu öğrenciler de anlaşma yapsınlar ve iki kalem de çoğunlukla güçlü olan da kalsın.

Ametal 1: Kalemini bana ver.

Ametal2: Hayır vermem. Asıl sen kendininkini bana ver

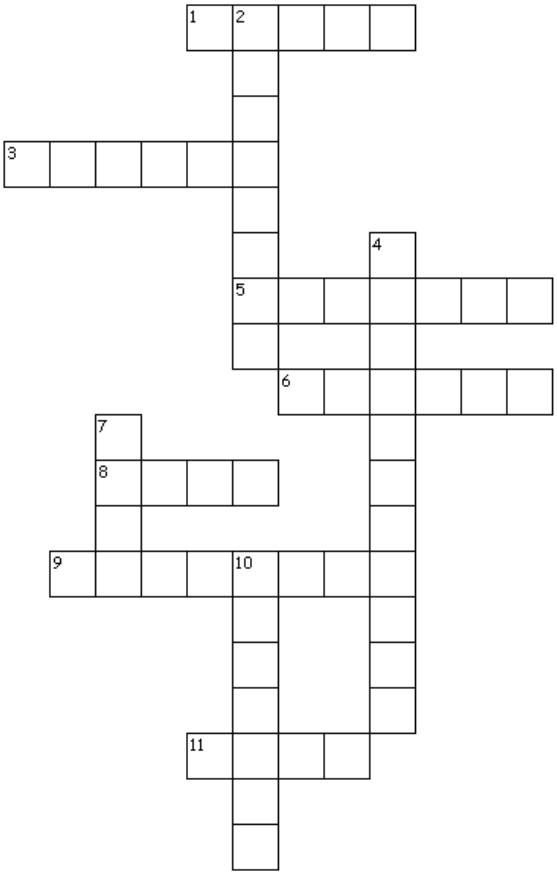
…….

Ametal1: O zaman kalemler en çok bende duracak çünkü ben daha güçlüyüm.

Ametal2: Kabul ediyorum ama bazen de bende kalsın.

Aktivite 4

Merhaba Arkadaşlar! Aşağıda verilen bulmacayı grup arkadaşlarınızla birlikte çözünüz.



1.Atomların değerlik elektronlarının sembolleri çevresine konulmasına..... yapısı denir.

2. İyonik bağ metal ve ametal atomları arasında ..... alışverişiyle oluşur.

3. Metal ve ametal atomları ..... bağları oluştururlar.

4.Aynı yada farklı tür atomlar kuvvetli etkileşimlerle bir araya gelerek..... oluştururlar.

5. Ametaller yarı dolu.....lerini elektron alarak doldururlar.

6. Atomlar bağ yaparak ..... düzenine geçmeye çalışırlar.

7. Klor atomunun son yörüngesinde ..... değerlik elektronu vardır

8.Elektron alan ametal atomu ..... yükle yüklenir.

9. Bağ oluşurken maddelerin kimyasal ve ..... özellikleri değişir.

10. Bağ oluşurken atomlar daha..... duruma geçerler.

11. Elektron veren metal atomu ..... yükle yüklenir.

Çalışma Kağıdı 5

Grup Adı:

1) Kovalent bağın 2 temel özelliğini yazın.

a) .....

b) .....

2) Aşağıda verilen cümlelerde boşluklara gelecek kelimeleri yazın.

a)..... ametal atomlarının elektronları ortaklaşa kullanmasıyla oluşur.

b) Aynı tür ametal atomları ..... bağları oluştururlar

c) Farklı tür ametal atomları.....bağları oluştururlar.

d) Hidrojen ve Lityum atomları son yörüngelerindeki elektron sayılarını 2 ye tamamlayarak.....kuralına uyarlar. Bu atomlar dışındaki diğer atomlarda son yörüngelerindeki elektron sayılarını sekize tamamlarlar. Buna ..... kuralı denir.

e) Aynı yada farklı tür atomların birbirine kovalent bağlarla bağlandığı en küçük birime ..... denir.

f) Bir moleküldeki atomların sayısını gösteren formüle ..... formülü denir.

dublet, molekül, oktet, polar kovalent, molekül formülü, apolar kovalent, kovalent bağ,

Çalışma Kağıdı 6

Adı:

Soyadı:

Sınıfı:

No:

Aşağıda verilen bileşiklerin türünü boşluklara yazınız.

H_2O	NaCl	$MgCl_2$	CCl_4
H_2S	CaO	O_2	N_2
RbCl	HF	HCN	Cl_2

İyonik	Kovalent	
	polar	apolar

ÇOKLU ZEKAYA DAYALI DERS PLAN ÖRNEĞİ IV

Ders: Kimya

Ünite: Maddenin Yapısı

Konu: Kimyasal Bağlar

Sınıf: 9

İçerik taslağı:

- Metalik bağ
- Bağlar ve maddenin halleri
- Moleküller arası bağlar

1. Van der Waals bağları
2. Dipol-dipol bağları
3. Hidrojen bağları

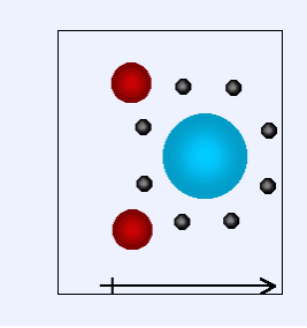
Hedef Davranışlar:

- Metal bağlarını tanımlama
- Bağlar ve maddenin halleriyle ilişki kurabilme
- Moleküller arası bağ çeşitlerini tanımlama
- Moleküller arası bağ çeşitlerine örnekler verme
- Moleküller arası bağ çeşitleriyle ilgili problemler çözme
- Maddelerin fiziksel ve kimyasal özellikleriyle bağlar arasında ilişki kurabilme

Gerekli Malzemeler: Aktivite ve çalışma kağıtları, bilgisayar ve projeksiyon cihazı

Hitap ettiği zeka türleri: sözel-dilsel, görsel-uzamsal, sosyal, öze dönük, müziksel zeka.

Dersin İşlenişi: Bir önceki dersteki konuları öğrencilere sorular sorarak kısaca tekrar ediniz.(5 dakika) Daha sonra öğrencilere bildikleri diğer bağ çeşitlerini sorunuz. Hep beraber konuyla ilgili kısa



bir tartışmadan sonra Suyun polar bir molekül olduğunu gösteren yandaki animasyonu gösterin.

Bu animasyondan sonra yine bilgisayar yardımı ile sudaki Hidrojen bağını gösteren şekilleri gösterin ve öğrencilerden şekilleri yorumlamalarını isteyin.

Öğrencilerden molekül içi yada moleküller arası bağlarla ilgili olarak şarkı şiir yada hikaye yazmalarını isteyin. Daha sonra *Çalışma kağıdı 7* yi dağıtın ve grupça cevaplamaları için 15 dakika süre verin ve süre bitiminde cevapları beraberce tartışın.

Daha sonra *çalışma kağıdı 8* i dağıtın ve kişisel olarak cevaplamalarını isteyin.

Değerlendirme: *Çalışma kağıdı* 8 i toplayıp not verin.

Çalışma Kağıdı 7

Grubun Adı:

1. 

Cl_2 Br_2 I_2

Sevgili öğrenciler şekilde verilen moleküllerin moleküller arası Van der Waals kuvvetleri aşağıdaki gibi sıralanmıştır.

$Cl_2 < Br_2 < I_2$

a) Bu sıralamaya bakarak ve periyodik tabloyu göz önünde bulundurarak Van der Waals kuvvetlerinin Cl_2 de en zayıf I_2 de en kuvvetli olmasının nedeni neler olabilir?

b) Moleküller oda koşullarında hangi hallerde bulunabilirler?

2. Soy gaz atomları arasında hangi bağlar bulunur?

3. Van der Waals bağlarının oluşumunu kısa bir paragraf yazarak açıklayınız.

4. Aşağıda verilen bileşiklerin *<u>molekülleri</u>* arasında hangi bağ çeşitleri bulunur?

H_2: HF:

Ne: O_2:

OF_2: HCl:

H_2S:

5. Metal bağlarıyla ilgili olarak aşağıdaki bilgiler verilmiştir

a) Li atomları arasındaki bağlar Rb atomları arasındaki bağlardan daha kuvvetlidir.

b) Na elementinin erime sıcaklığı Cs elementinin erime sıcaklığından daha yüksektir.

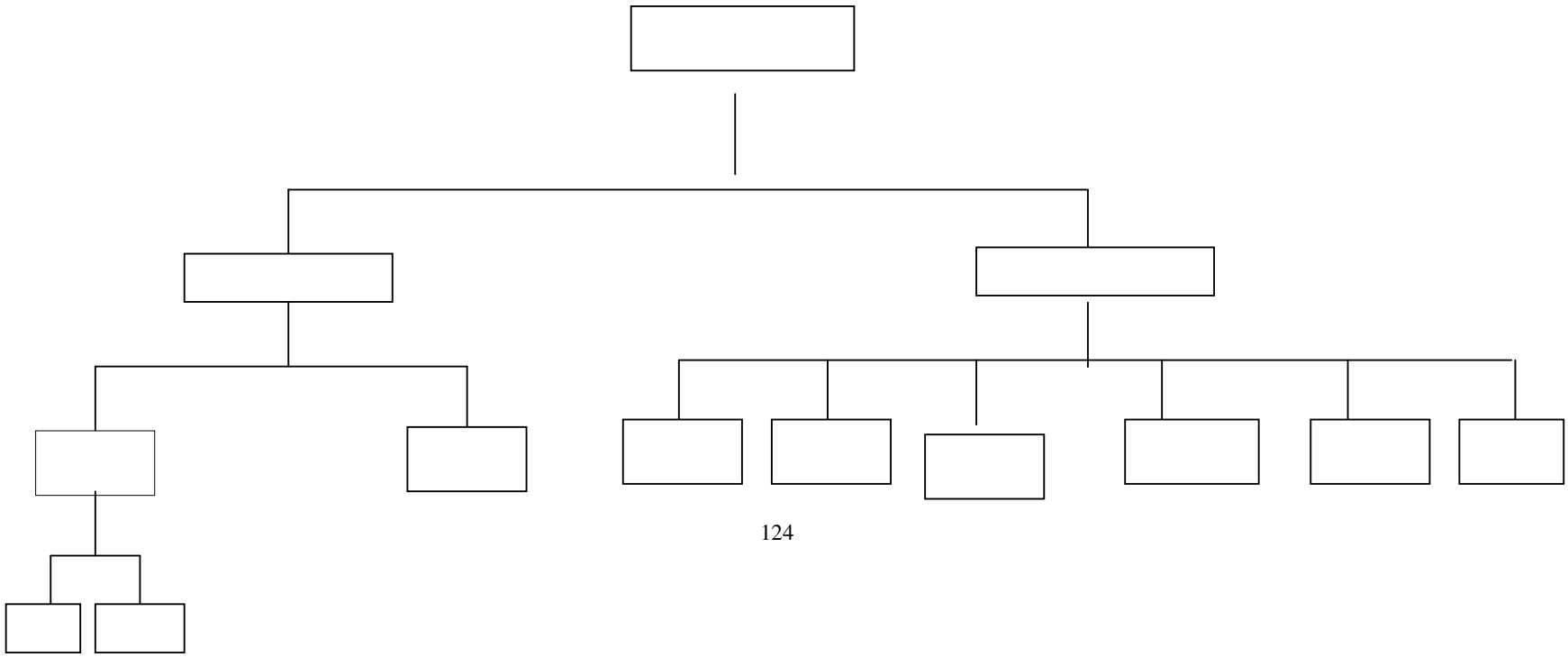
Bunun sebebi ne olabilir?

Çalışma Kağıdı 8

KAVRAM HARİTASI

Merhaba arkadaşlar!

Aşağıda bağlarla ilgili olarak bir kavram haritası verilmiştir. Kutulardaki boşlukları doldurunuz.



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ÇOKLU ZEKAYA DAYALI DERS PLAN ÖRNEĞİ V

Ders: Kimya

Ünite: Maddenin Yapısı

Konu: Kimyasal Bağlar

Sınıf: 9

Süre: 45 dakika

İçerik taslağı:

Bileşikler

- İyon yapılı bileşikler

Hedef Davranışlar:

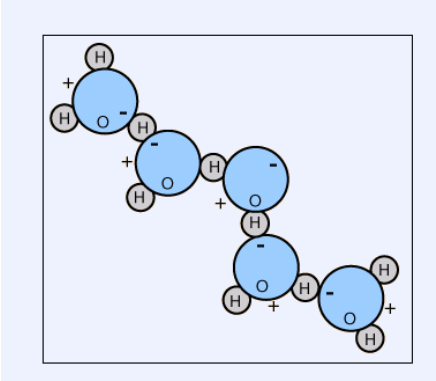
- Bileşiği tanımlama
- Bileşiklere örnekler verme
- Bileşikleri karışımlardan ayırt edebilme
- Bileşik çeşitlerini tanımlama
- İyon yapılı bileşikleri tanımlama
- İyon yapılı bileşiklere örnekler verme
- İyon yapılı bileşiklerin elektrik iletkenliğini gösterme
- İyon yapılı bileşiklerle ilgili deney düzeneği kurma

Malzemeler:

Çalışma ve aktivite kağıtları, aktivite 5 teki deney malzemeleri

Hitap ettiği zeka türleri: *Bedensel-kinestetik, görsel-uzamsal, sözel-dilsel, matematiksel-mantıksal, öze dönük, sosyal zeka, doğa zekası.*

Dersin İşlenişi:



Bugün ki derste bileşikler konusuna başlanacağı ve iyon yapılı bileşiklerle ilgili bir deney yapılacağını bildiriniz. Daha önceden çalışmış olarak gelmeleri gerekmektedir. Sınıfı dört gruba ayırarak öğrencilere ders kitaplarını kullanarak *Aktivite 5* teki deney düzeneğini kurmalarında rehberlik ediniz. Deneyi yaparken her adımda gözlemlerini yazmalarını söyleyiniz.

Deney tamamlandıktan sonra deney sonuçlarını diğer gruplarla karşılaştırmalarını isteyiniz ve *çalışma kağıdı 9 u* doldurmalarını isteyiniz.(5 dakika). Sonuçları hep beraber tartışınız.

Değerlendirme: *Çalışma kağıdı 9 u* toplayıp not verin.

Aktivite 5

Merhaba arkadaşlar

Aşağıdaki deneyi ders kitabınızdaki düzeneği kurarak grup arkadaşlarınızla birlikte yapınız. Elde ettiğiniz sonuçları not alınız.

Deneyin Amacı: İyonik yapılı bileşiklerin sulu çözeltilerinin elektrik akımını ilettiğinin gösterilmesi

Gerekli Malzemeler:

Güç kaynağı (DC)

Ampermetre

Beherglas (250 mL)(2 adet)

Bağlantı kabloları (4 adet)

Çelik elektrot (2 adet)

Ampul (1,5 volt)

Bakır (II)klorür ($CuCl_2$)

Bağlama kabloları(2 adet)

Dereceli silindir (100 mL 1 adet)

Sodyum Klorür

Duy

damıtık su

cam çubuk

spatül

Deneyin Yapılışı :

1.) Kitabınızdaki devreyi kurunuz.
2.) Bir miktar sofra tuzunu boş bir beherglasa koyup elektrotları tuz yığınının iki tarafında gezdirin. Güç kaynağını açıp ampulün yanıp yanmadığına ve ampermetrenin ibresinde sapma olup olmadığına bakınız. Aynı işlemi katı $CuCl_2$ için de yapınız.

3.) Temiz bir bir beherglasa damıtık su koyunuz ve güç kaynağına açıp ampulün yanıp yanmadığını ve ampermetrenin ibresini kontrol edin ve sonuçları kaydedin. Güç kaynağını kapatın.(Elektrotların çıplak uçlarını birbirine değdirmeyin).

4.) Beherglastaki damıtık suya tuz ilave edip cam çubukla çözününceye kadar karıştırın. Güç kaynağını açın ve ampul ve ampermetreyi gözlemleyin. Sonuçları kaydedin.

5.) Akımı kestikten sonra tuz çözeltisine azar azar tuz ilave ederek akım şiddetini ve ampulün parlaklığını gözlemleyin. Gözlemi her tuz ilavesinde yapınız.

6.) Elektrotları çözeltiden çıkarıp yıkayınız. Beherglası boşaltıp yıkayınız.

7.) Dört ve beşinci işlemleri $CuCl_2$ için de tekrarlayınız.

8.) Gözlem sonuçlarını diğer gruplarla karşılaştırınız.

Çalışma Kağıdı 9

Adı:

Soyadı:

Sınıfı:

No:

İyon Yapılı Bileşikler

Deney Sonu Sorular

1) Katı halde NaCl ve $CuCl_2$ elektrik akımını iletti mi?
2) Damıtık su elektrik akımını iletti mi?
3) Dördüncü adımda suya tuzun ilave edilmesiyle çözeltinin iletkenliğinde nasıl bir değişme gözlenmektedir nedeni ne olabilir?

4) 5. Adımda çözünen NaCl miktarı arttıkça iletkenlik nasıl değişti? Suda daha çok NaCl nin çözünmesi daha çok Na+ ve Cl- nin oluşması demektir. Çözeltideki iyon miktarı ile iletkenliği arasında bir ilişki varmıdır?

5) Deney iyonik bileşiklerin sulu çözeltilerinin elektrik akımını ilettiğini gösterir mi?

Bu deneyden yola çıkarak iyon yapılı bileşiklerin özelliklerini sıralayabilir misiniz?

1) .....
2) .....
3) .....
4) .....
5) .....

ÇOKLU ZEKAYA DAYALI DERS PLAN ÖRNEĞİ VI

Ders: Kimya

Ünite: Maddenin Yapısı

Konu: Kimyasal Bağlar

Sınıf: 9

Süre: 45 dakika

İçerik taslağı:

Bileşikler

- Molekül yapılı bileşikler

Hedef Davranışlar:

- Molekül yapılı bileşikleri tanımlama
- molekül yapılı bileşiklere örnekler verme
- molekül yapılı bileşiklerin elektriği iletmediğini gösterme
- molekül yapılı bileşikler için deney düzeneği kurma

Malzemeler:

Çalışma ve aktivite kağıtları, aktivite6 da ki deney malzemeleri

Hitap ettiği zeka türleri: *Bedensel-kinestetik, görsel-uzamsal, sözel-dilsel, öze dönük, sosyal zeka.*

Dersin İşlenişi:

Öğrencileri dört gruba ayırınız. Her grup için temsilci seçin. Bugün ki konunun molekül yapılı bileşikler olduğu ve derste bu konuyla ilgili deney

yapılacağını söyleyiniz. *Aktivite 6* yı dağıtınız. Öğrencilere yardım ederek kitaplarındaki deney düzeneğini kurmalarını sağlayınız.

Deneyi yaparken her adımda gözlemlerini yazmalarını söyleyiniz. Deney tamamlandıktan sonra deney sonuçlarını diğer gruplarla karşılaştırmalarını isteyiniz ve her gruba *çalışma kağıdı 10 u* dağıtınız ve molekül yapılı bileşiklerin özelliklerini tartışınız.

Değerlendirme: *Çalışma Kağıdı 10 u* toplayınız. Gruplardan *çalışma kağıdı 11* i grupça tartışarak cevaplamalarını isteyiniz.

Aktivite 6

Arkadaşlar kitabınızdaki deney düzeneğini kurarak aşağıdaki deneyi grup arkadaşlarınızla birlikte yapın ve sonuçları not alın.

Molekül Yapılı Bileşikler

Deneyin Amacı: Molekül yapılı bileşiklerin elektrik akımını iletip iletmediğinin gözlemlenmesi

Gerekli Malzemeler:

Güç kaynağı(DC)
Beherglas(250 mL)(2 adet)
Bağlantı kabloları (4 adet)
Çelik elektrot (2 adet)
Ampul (1,5 volt)
Şeker
krokodil
Duy
Asetik asit
Dereceli silindir
damıtık su
cam çubuk
spatül

Deneyin Yapılışı:

1. Beherglasa 150 mL damıtık su koyup akımı iletip iletmediğini gözlemleyiniz. Güç kaynağını kapatınız.
2. Beherglasa azar azar toz şeker ilave ediniz. Her şeker ilavesinde güç kaynağını açıp akımda nasıl bir değişme olduğunu gözlemleyiniz. (Toz şeker ilave ederken akımı kesiniz)

3. Beherglası boşaltıp yıkayınız ve içine 150 mL saf su koyunuz

4. Bir başka beherglasa saf asetik asitten 100 ml koyarak içine elektrotları batırınız. Güç kaynağını açıp saf asetik asitin akımı iletip iletmediğine bakın ve not alın.

5. Elektrotları saf asitten çıkarıp yıkayarak diğer beherglastaki saf suya daldırınız. Beherglastaki saf asetik asit çözeltisinden 1-2 mL saf suya ekleyip akım vererek oluşan çözeltinin elektrik akımını iletip iletmediğine bakıp not alın.
6. Güç kaynağını açınız ve ampulün yanıp yanmadığını gözlemleyiniz.

Çalışma Kağıdı 10

Adı:

Soyadı:

Sınıfı:

No:

Molekül Yapılı Bileşikler

Deney Sonu Sorular

1.) Şeker suda çözündüğünde iyon oluşturur mu?

2.) Saf asetik asit elektrik akımını iletiyor mu? Saf asetik asit içinde iyonlar var mıdır?

3.) Saf suya asetik asitten birkaç mL eklenince oluşan çözelti elektrik akımını iletiyor mu?

4.) Asetik asit molekül yapılı olmasına rağmen suda çözündüğünde iyon oluşturur mu? Açıklayınız.

Bu deneyden yola çıkarak molekül yapılı bileşiklerin özelliklerini yazabilirmisiniz?

1) .....

2) .....

3) .....

4) .....

5) .....

Çalışma Kağıdı 11

Grup Adı:

1) Aşağıda gördüğünüz resmi yorumlayabilir misiniz?