



## KNOWLEDGE LEVELS OF PROSPECTIVE SCIENCE TEACHERS ON THE SUBJECT OF CARBOHYDRATES

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### Abstract:

The purpose of this study is to measure the knowledge levels of prospective science teachers who took General Biology I course on the subject of carbohydrates and to find out their misconceptions. The study was conducted with 35 prospective teachers in their third year at Sinop University, Faculty of Education Science teaching department. Qualitative research design was used in this study. The students were given a form consisting of 10 open-ended questions about carbohydrates. The data obtained were analyzed with content analysis method. It was found that students could not remember some important concepts about carbohydrates or that they had incomplete or incorrect information. Taking the results into consideration, various recommendations were made to correct the incomplete or incorrect information and to reach permanent knowledge.

**Keywords:** carbohydrate, glucose, prospective science teachers, level of conceptual comprehension

### 1. Introduction

Due to the subjects and abstract concepts it includes, science is one of the areas students have difficulty in understanding (Ayas and Coştu, 2001). A great number of researchers have reported that students form some information in their minds and tend to interpret new information based on the information that they already had (Mintzes and Wandersee, 1998; Köse et al., 2003). According to Mintzes and Wandersee (1998), comprehending and learning well the basic concepts learned at the beginning will increase the correctness of concepts learned later. Misconceptions can occur due to different reasons such as teaching and learning environment (not including much

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practice and visuals), students' lack of knowledge, teacher (teaching strategy, insufficient material), language used and course book (lack of content, lack of figures and examples, incorrect information) (Gilbert, 1977; Bahar et al., 1999, Aşçı et al., 2001). It is very important in science teaching to find out which subjects students have difficulty in learning and to develop a teaching environment and method accordingly (Novak, 1993). Since the concepts in science courses are mostly abstract, it is difficult for students to picture these concepts in their minds. There are a great number of studies which have found students' level of information and misconceptions in the subjects of cell structure and function (Marek, 1986), anatomy (Arnoudin and Mintzess, 1985), growth and development (Smith and Anderson, 1984), protein, enzyme, protein synthesis (Selvi and Yakışan, 2004; Sinan et al, 2006), osmose and diffusion (Zukerman, 1994; Odom, 1995), photosynthesis (Eisen and Stavy, 1988; Amir and Tamir, 1994; Tekkaya and Balcı, 2003; Köse, 2004), genetic (Aydın, 1999), cellular division (Atılboz, 2004; Emre and Bahşı, 2006), respiration (Yürük and Çakır, 2000; Alparslan, 2002), cell metabolism (Storey, 1991) and classification (Saka et al., 2002, Köse et al., 2007); however, no studies have been found on carbohydrates in organic matter, which is one of the basic subjects of general biology.

A great number of studies have shown that traditional methods used in science teaching are insufficient in eliminating misconceptions (Ayas et al., 1994; Köse, 2004; Akgün and Aydın, 2009). The aim of this study is to find out the knowledge level of prospective science teachers on carbohydrates and to find out which concepts they have difficulty in understanding.

## **2. Material and Methods**

### **2.1 Research Model**

Qualitative research method was used in this study. A qualitative data collection tool consisting of open-ended questions was used in the study. The questions prepared for this purpose were prepared in line with the opinions of academics and secondary education teachers who were experts in their fields. The students were interviewed and they were given a form consisting of 10 open-ended questions. The data were analyzed with content analysis method. In a qualitative research, the data should be approached in detail for reliability (Creswell, 1994). In our study, the answers given by prospective teachers to questions were conveyed in detail.

### **2.2 Research Group**

The universe of the study consists of students studying in Sinop University, Faculty of Education Science teaching program during 2015-2016 Academic Year. The sample consists of 35 students in their third year of study who were chosen from this universe. Prospective teachers take General Biology I in the first semester of the second year. For this reason, in order to measure the level of knowledge about carbohydrates, the research group was chosen among students in their third year who took this course.

## 2.3 Data Collection Tools

While preparing the questions, Secondary Education Biology (1-2-3) draft teaching program in February 1998 dated and 2485 numbered journal of reports and the content of General Biology I course were used. The form includes 10 open-ended questions including the subjects considered as the most important on the subject of carbohydrates. The questions prepared with content analysis were applied on different student groups, the results were assessed and the form was finalized.

## 3. Results

### 3.1 Questions

**Table 1:** The answers given to question 1

Question 1: Which matters can be found in which ratios in the structure of carbohydrates?		F	%
1	1:1 C and H	3	8.5
2	1:2:1 C, H and O	20	57.1
3	C, H and O	4	11.4
4	N, C and O	1	2.8
5	Equal amount of N, H and N	1	2.8
6	No answer	6	17.1

When the answers given to this question were analyzed, the number of students who gave the correct answer 1:2:1 C, H and O is 20, while their percentage is 57.1. There were also 4 students who answered as C, H and O without knowing the ratio.

**Table 2:** The answers given to question 2

Question 2: Classify carbohydrates		F	%
1	Monosaccharide, disaccharide	6	17.1
2	Monosaccharide, disaccharide, polysaccharide	23	65.7
3	Glucose, fructose, starch	1	2.8
4	Glucose, saccharose	1	2.8
5	Starch and glycogen	2	5.7
6	DNA, RNA	1	2.8
7	No answer	1	2.8

The percentage of students who classified correctly was 65.7%. While classifying, some students wrote sub-units such as starch, glycogen, glucose and fructose.

**Table 3:** The answers given to question 3

Questions 3: Write three examples of polysaccharides		F	%
1	Starch and glycogen	15	42.8
2	Cellulose, starch, glycogen	10	28,5
3	Glucose, galactose, fructose	5	14.2
4	Glucose	1	2.8
5	Glycogen	1	2.8
6	No answer	3	8.5

The number of students who gave the correct answer of cellulose, starch, glycogen is 10. 15 students with a rate of 42.8% gave the answer starch and glycogen. The number of students who could remember starch and glycogen was higher.

**Table 4:** The answers given to question 4

<b>Question 4: Write down the significance of carbohydrates</b>		<b>F</b>	<b>%</b>
1	They are the nutritional source of living beings	2	5.7
2	They are the nutritional source first resorted to	7	20
3	They make digestion easier, they break down easily and they give energy	5	14.2
4	They give energy	2	5.7
5	They are the energy source first resorted to. They are stores of spare food. They participate in the structure of cell membrane. They are also found in DNA and RNA structure.	10	28.5
6	They are in membrane structure. They give energy. They are stores of spare food.	5	14.2
7	They give energy. They are stores for birds and mammals. They give energy.	4	11.4

When the answers given to fourth question were analyzed, it was found that only 28.5% of the students could explain the significance of carbohydrates fully. Some students could write only some of its duties. 4 students confused carbohydrates with lipids.

**Table 5:** The answers given to question 5

<b>Question 5: How are disaccharides formed? Give an example of disaccharides</b>		<b>F</b>	<b>%</b>
1	Two monosaccharides join together, with one water outlet; for exp maltose	17	48.5
2	Two glucose join together; for exp sucrose	10	28.5
3	Monosaccharides join together	5	14.2
4	Polysaccharides join together; for exp starch	1	2.8
5	Glucose units bind together; for exp galactose	1	2.8
6	No answer	1	2.8

While 17 students answered correctly, 10 students confused monosaccharides and glucose. 14.2% of the students answered correctly by saying monosaccharides join together; however, they did not give any example.

**Table 6:** The answers given to question 6

<b>Question 6: What is the name of the bond in carbohydrates?</b>		<b>F</b>	<b>%</b>
1	Glycoside	23	65.7
2	Ester	4	11.4
3	Peptide	3	8.5
4	Phosphate	2	5.7
5	No answer	3	8.5

23 students were found to answer correctly.

**Table 7:** The answers given to question 7

Question 7: In which structures are ribose and deoxyribose found?		F	%
1	Deoxyribose-DNA Ribose-RNA	29	82.8
2	Deoxyribose-RNA Ribose-DNA	3	8.5
3	DNA	1	2.8
4	RNA	1	2.8
5	Carbohydrate	1	2.8

The number of students who answered correctly is 29 with a percentage of 82.8. 3 students remembered the terms reversely.

**Table 8:** The answers given to question 8

Question 8: Where is glycogen stored?		F	%
1	Liver and muscle	11	31.4
2	Muscle	5	14.2
3	Liver	6	17.1
4	Inner organs	9	25.7
5	Adipose tissue	1	2.8
6	Brain and small intestine	3	8.5

11 students with a percentage of 31.4 answered correctly by saying liver and muscle.

**Table 9:** The answers given to question 9

Question 9: What is pentose?		F	%
1	Sugar with 5 C	9	25.7
2	Ribose and deoxyribose	8	22.8
3	Carbohydrate	2	5.7
4	It is in the structure of glucose	2	5.7
5	Lipid	1	2.8
6	No answer	13	37.1

9 students answered correctly by saying sugar with 5 C, while 8 students answered partly correctly by saying ribose and deoxyribose.

**Table 10:** The answers given to question 10

Question 10: How is carbohydrate stored in plants and animals?		F	%
1	Starch in plants, glycogen in animals	20	57.1
2	Cellulose in plants, glucose in animals	3	8.5
3	Starch in plants, glucose in animals	11	31.4
4	No answer	1	2.8

20 students answered this question correctly by saying starch in plants and glycogen in animals. 11 students were found to confuse the terms of glycogen and glucose.

#### 4. Discussion and Conclusion

The aim of this study is to measure students' knowledge and misconceptions about carbohydrates. The students in the study took General Biology I in the second year of their undergraduate education. However, it was found that they had incorrect or missing information about carbohydrates or that they could not remember some important concepts in the subject of carbohydrates. One of the important points in the study is that very general information about carbohydrates is remembered easier, while misconceptions and incomplete information increase when it gets a bit more detailed. For example, in the first question, the substances which formed the structure of carbohydrates were known in higher rates, while success was lower in the rates of substances. As can be seen in question 3, the number of students who could give 3 examples about polysaccharides is 10. The number of students who could give 2 examples is 15. It was found that especially the words that were alike were confused with each other in the study. In terms of the distribution of answers, the most remembered terms were polysaccharide, glycogen and starch. A great number of students were found to confuse disaccharide and polysaccharide. The most remembered concepts were glucose, glycogen and starch. When question 4 which asked about the significance of carbohydrates was examined, 10 students wrote its functions and significance fully, while 33 students stated that they gave energy. 2 of the students only said that they took part in the structure of membrane, while 4 students confused it with lipids and said that they were energy stores for mammals and birds. 5 of the students stated that it was easy to digest them and that they could break down easily, while 7 students stated that they were the energy sources first resorted to. What is attention gathering in this question is that students knew in general that carbohydrate is an energy giving nutrient. Success was lower in details such as it participates in the structure of cell membrane and it is in the structure of DNA and RNA. Except for 10 students who could answer the question fully, none of the students wrote that they were in the structure of nucleic acids. In the question about disaccharides, 10 students confused monosaccharide and glucose. Ribose and deoxyribose were one of the most correctly remembered questions and 29 students correctly answered that deoxyribose is in DNA, while ribose is in RNA. One of the interesting answers was in question 8, where students in general remembered that glycogen is stored in the liver and there were fewer students who answered as muscle. In question 10, it was found that students confused glycogen with glucose and they had a misconception about this. The fact that they have such incorrect and missing information brings along the necessity of referring to different teaching technologies more, starting from primary education.

Using traditional methods frequently in science teaching prevents students from remembering concepts correctly. One of the reasons why the rate of failure is high in science teaching is the fact that subjects are presented in an abstract way (Üstün et al., 2001). Bahar and Özatlı (2003) conducted a study to examine the cognitive structure related with the primary compounds of living beings in 9th graders. In this study, it was found especially in pre-test that the word carbohydrate was matched with air. It

was thought that the reason for this was that students confused the word carbondioxide with carbohydrate. In another study, it was found that prospective science teachers had a perception that the substances most found in the body were carbohydrates and fats since they easily turned into energy (Sinan et al, 2006). Sert Çıbık et al. (2008) examined the effect of demonstration experiments on prospective science teachers in knowledge about photosynthesis and found that the success of students who took the course of science laboratory practices based on conceptual change approach were much higher than the success of students who took the course based on traditional approach. Especially techniques based on experimentation and methods conducted with the participation of students will increase success in biology. In addition to these, it can be tested at the beginning of the semester in which concepts students have problems with some tests including the subjects of the course in order to find out students' level of knowledge.

Applying different methods in science lessons is effective in eliminating misconceptions (Üce and Sarıçayır, 2002; Bahar and Özatlı, 2003; Akgün and Aydın, 2009; Qablan and DeBaz, 2015). In order to eliminate misconceptions, first of all the existing incorrect information should be changed (Smith et al., 1993). In order to do this, different teaching technologies should be used. Recently, computer technologies have gained importance in teaching (Şahan, 2005). Sounds and animations should be used more in biology. This way, subjects which students have difficulty in understanding will be structured more easily (Demirci, 2003).

Finding out in which subjects and concepts prospective teachers have difficulties is possible only by conducting some studies. Teaching permanent and correct information is possible only with the combination of suitable teaching technologies. Çepni et al. (2006) examined the effect of computer assisted teaching material about photosynthesis and stated that this method was effective in understanding cognitive field.

Visually presented information becomes much more permanent while memorized concepts are forgotten quickly. It may not be possible to present all subjects through experiments; in this case, especially visuals and animations can be used. Apart from these, exemplifying the concepts as much as possible will always cause better results than memorization.

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