Nephron Model For Course Teaching Material Purpose

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ABSTRACT

A successful science education aims to provide individuals with the knowledge and skills they will need in their daily lives. In biology teaching, both educational situations and abstract and complex biology concepts lead to students having difficulty understanding some topics and learning by memorizing them without understanding them. The aim of our project is to prepare visual material that will facilitate the understanding of the structure and function of Nephron by students in Biology courses from the subjects belonging to the excretory system.

Key words: *Nephron, Kidney, Material, STEAM, Biology*

1 Introduction

The main purpose of today's education is; It should be to raise people who can ask questions, say no, take critical decisions, use initiative, have sufficient communication skills, cope with new environments and establish new relationships. Today's individuals are not "knowledge memorized" individuals who grew up in the traditional school; must be "learning individuals"(Okutan, 2004).

Today, science education focuses on improving the science literacy of individuals. A successful science education aims to provide individuals with the knowledge and skills they will need in their daily lives (Anderson, 2010). Since science literate individuals have the skills to access and use the information they need to solve the problems they encounter, they have more advanced problem-solving skills (Kaptan, 1998).

Biology is very difficult to teach and learn because it includes complex relationships between foreign and abstract concepts. In biology teaching, both educational situations and the abstract and complex nature of biology concepts cause students to have difficulty in understanding some subjects and to learn by memorizing without understanding (Kılıç ve Sağlam, 2004). In order to solve this problem, the use of educational technologies in biology lessons is extremely important. Well-prepared pictures, three-dimensional models, animated animations, interactive environments, etc. It makes it easier to understand the targeted information (Çömlekçioğlu ve Bayraktaroğlu, 2001).

In order to convey learning and teaching in a real sense, technology has a great importance as well as the use of tools and equipment in biology education. Tools in the learning-teaching process are generally used to support teaching, well-prepared tools enrich the teaching process. It is known that meaningful learning occurs when the concepts are modeled or visualized as much as possible, and even when videos explaining the related concept are used in the science lesson (Coştu, Beler, Coştu, 2017).

Recent studies in the cognitive field show that students learn better when their minds are actively engaged in research, moving from (traditional) teaching and learning to exploratory learning (Harris et al, 2001).

The lack of importance given to laboratory activities in schools and the difficulties in preparing materials related to 11th grade human physiology make it difficult to teach concepts. Therefore, it is important to prepare and use the material of the nephron model, which is the basic part in understanding the excretory system.

The aim of our project; To prepare visual materials that will facilitate students' understanding of the structure and function of the Nephron, which is one of the subjects of the excretory system, in the 11th grade Biology course of secondary education.

1-1 Constructivist Approach in Education

The reorganization of the curricula according to the constructivist approach in the Turkish Education System can be described as the biggest change. Curriculums are based on student-centered and active participation teaching activities rather than teacher-centered teaching (Arslan ve Özpınar, 2009; Peker ve Halat, 2008). However, in studies on new curriculums in Turkey, teachers' opinions are frequently encountered regarding "significant disruptions in the implementation of the curriculum due to the lack of structures, tools, materials and materials" (Akça, 2007, Peker ve Halat, 2008, Şahin, 2010).

Constructivism is based on the understanding that learning is a process that takes place in the mind of the individual. For this reason, information cannot be stored by transferring it to the human mind, and the human mind is not an empty place where all information is stored (Yaşar, 1998, s.69).Therefore, constructivism is the meaning that an individual produces in his mind as a result of perceiving, processing, evaluating and reasoning about the events in the outside world (Ersoy, 2003). Constructivism is concerned with solving problems that best fit real-life situations. This theory requires students to make choices about what and how to learn. Students learn by working collaboratively in groups and achieve success by trying solutions to problems and developing a presentation, not just as the teacher conveys (Kaptan ve Korkmaz, 2000).

The main feature of constructivist theory lies in defining the role of students. In this process, the student actively constructs his/her ideas and perceptions, instead of passively receiving them from other sources or teachers. Structuring means that the learner uses their thoughts and perceptions shaped by their previous experiences to associate and expand their new experiences. This can be

associate and expand their new experiences. This can be achieved through mental activities or sometimes through physical activities, that is, by doing and living (Harlen, 2000).

1-2 Material Development and Model Teaching Method

With the developing and changing conditions, educators and those who need other presentation technologies can easily find the teaching tools and materials they need in the market. However, these can sometimes be difficult, time-consuming and expensive to achieve. In these cases, teachers can prepare some of the tools and materials they need themselves, or they can have students prepare by guiding them (Şahin Yanpar-Yıldırım, 1999; İşman, 2008).What makes the use of materials in education so valuable is the linear relationship between learning and sense organs. Students learn 83% of their learning by sight, 11% by hearing, 3.5% by smell, 1.5% by touch and 1% by taste. In addition, people remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say and 90% of what they do and say (Ergin, 1995; Kılıç, 1997). The effect of seeing and hearing on learning at this rate makes the design of visual materials extremely important.

Model Teaching Method; It is a teaching method applied with the help of examples of real objects made of the same or other material, and objects brought to the classroom from their natural environment. Models can be larger or smaller than the original object, or they can be exactly the same size and structure as the real object they replace (Çilenti, 1985).

Models are recognizable imitations of the real object. It may or may not be in working condition like the real object. However, the original is similar in everything except size. In addition, there are models that are visible inside or very simplified ones that are free of all details (Okan, 1993).

Concept education is basically providing the formation of cognitive schemas of the concepts to be learned and the winners by the students. It aims for students to acquire concepts from abstract to concrete, from complex to simple, according to their accessibility or descriptive order (Baba & Öksüz, 2015). Concept training is done with methods and techniques to reach a concept in the easiest and most meaningful way. Especially in the field of science, it is important for students to acquire concepts that are difficult to reach, dangerous, inaccessible even though they are abstract or concrete, both visually, audibly and descriptively by using models in the classroom environment and by making use of today's technology (Gülen, 2018; Tömen, Akdeniz, Odabaşı Çimer ve Gürbüz, 2013).

1-3 Filtration Unit "NEFRON" in Kidney

When the microscopic structure of the kidney is examined, structures called nephron are seen. The most important structural-functional unit of the kidney is the "filtration unit. The nephron, located in the shell region of the kidney, forms the core region of the kidney (Fig.1).

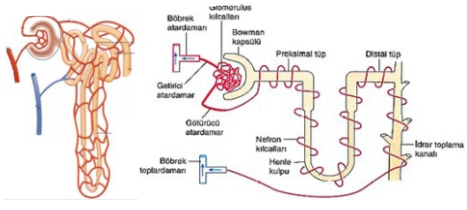

Fig. 1: Parts of the Nephron

The Malpighi body is the end or beginning of the nephron, the Bowman's capsule. The transmitting artery entering the Bowman's capsule divides into capillaries that form the glomerulus tuft. These capillaries join and exit the Bowman's capsule as the efferent artery. This ascending artery divides into renal capillaries, surrounds the nephron canals, and then joins together to connect to the renal vein. The nephron canal consists of three parts: Proximal tube, loop of Henle and Distal tube. In addition, urine collection channels open into the pool.

1-4 Renal Vessels

The renal artery enters the kidney from the pit and divides into thinner branches. Dirty in terms of O2 rich residue; however, metabolic waste products, except CO2, are abundant in his blood (Urea, NH3, uric acid and other chemicals to be excreted). Renal vein is clean in terms of CO2-rich residue.

I. Glomerulus capillary system (First capillary cyst): The branches entering the kidney are divided into thinner branches in the core and shell region and form the glomerulus capillaries.

II.Efferent Artery:Carries blood from the glomerulusto the 2nd blood system.

III. Second capillary system: The efferent artery emerging from the glomerulus divides into renal capillaries and forms the "second capillary system" that surrounds the nephron canals.

IV. Renal vein: These capillaries separate from the nephron canals and form the renal vein.

2 Materials and Methods

In our project, we designed a teaching material in order to make the structure and function of the Nephron, which performs the filtering-reabsorption-secreting function in the kidney, which is one of the subjects of the 11th grade biology course, excretory system unit, more understandable.

Material development method was used in the study. This method is used in educational materials developed based on the sensory, cognitive and psycho-motor characteristics of the student (Karamustafaoğlu, 2006).

Our project was carried out in the biology laboratory of our school. The construction stages of our project are as follows.

2-1 Ground Preparation of the Nephron Model

An upright floor was obtained by using 80 cm long and 50 cm wide chipboard and Styrofoam of the Nephron model (Figs. 2 and 3) .

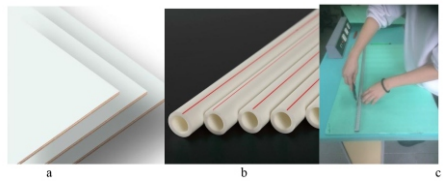

Fig. 2: a)hardboard b)PVC pipe c)styrofoam

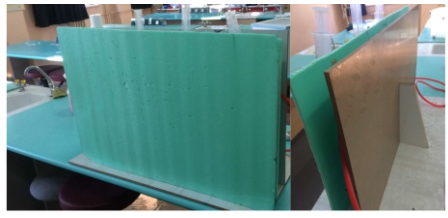

Fig. 3: final state

2-2 Nephron Model and Placement with PVC Pipe

The Nephron Model was designed using a PVC pipe with a diameter of 2 cm and a length of 155 cm used for water installation (Figs 4 and 5).

Fig. 4: Glomerulus design stage

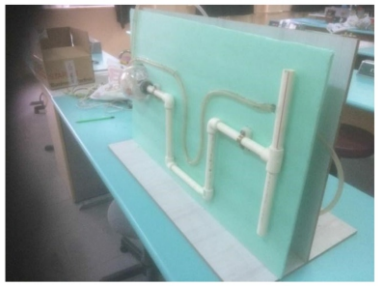

Fig. 5: Preparation of PVC pipe in appropriate dimensions

2-3 Placement of Blood Vessels Around the Nephron Model

For the blood vessel display in the nephron model, a 1 cm diameter and 220 cm long transparent tube shown in figure 3.5 was preferred. The transparent pipe was fixed to the Styrofoam floor with copper wires (Fig. 6).

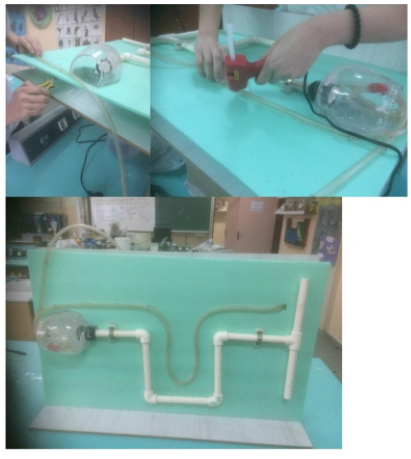

Fig. 6: Fixing the transparent tube for blood vessels to the model

2-4 Ensuring Blood Flow in the Transparent Tube

In order to ensure the movement of blood in the transparent tube, the aquarium in a container filled with red acrylic paint placed at the back of the nephron model was moved with the help of an internal filter motor. The functions of the parts of the nephron, which are shown blood flow, are pasted on the Styrofoam as notes (Fig. 7).

Fig. 7: Ensuring Blood Flow in the Transparent Tube

2- 5 Representation of Absorption Percolation Zone in the Nephron Canal

A glass sugar bowl was used for the Malpighi body filtration Bowman capsule. Glomerulus is shown with a transparent tube filled with red acrylic paint. One-way filtration occurs from the glomerulus capillaries to the Bowman capsule (Fig. 8).

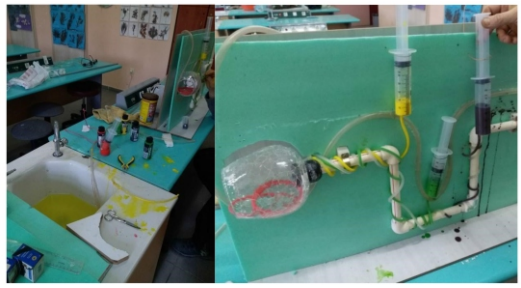

Fig. 8: Malpighi body

3 Conclusions

In order to symbolize the absorption of water, glucose, amino acids, vitamins, ions and urea absorbed from the filtrate in the proximal tube, a transparent tube filled with yellow acrylic paint was preferred. In addition, the syringe used was used to symbolize the absorption of suction from the proximal tube into the blood. In order to symbolize the absorption of the water absorbed from the filtrate into the blood in the descending arm of Henle, a transparent tube filled with green acrylic paint was preferred. In addition, the syringe used was used to symbolize the absorption of suction from the Henle descending arm into the blood. A transparent pipe filled with black acrylic paint was preferred in order to symbolize the absorption of salt absorbed from the filtrate into the blood in the arm leading out of Henle. In addition, the syringe used was used to symbolize the absorption of suction from the arm of Henle into the blood. In order to symbolize the absorption of water, Na, Cl and HCO3 absorbed from the filtrate in the distal tube, and the reabsorption of water and urea from the urine collection canal, a transparent tube filled with blue colored acrylic paint was preferred. In addition, the syringe used was used to symbolize the absorption of suction from the Distal tube and urine collection channel into the blood (Fig.9).

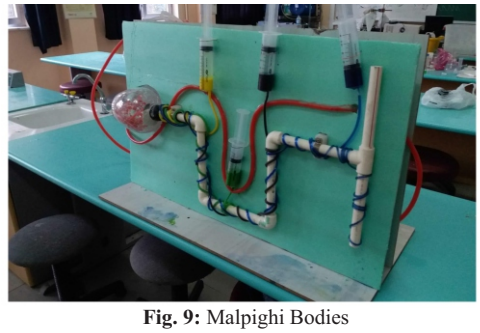

Fig. 9: Malpighi Bodies

4 Discussions

A successful science education aims to provide individuals with the knowledge and skills they will need in their daily lives (Anderson, 2010). Since science literate individuals have the skills to access and use the information they need to solve the problems they encounter, they have more advanced problem-solving skills (Kaptan, 1998). In biology teaching, both educational situations and the abstract and complex nature of biology concepts cause students to have difficulty in

understanding some subjects and to learn by memorizing without understanding (Kılıç & Sağlam, 2004). In order to overcome this problem, well-prepared three-dimensional models in biology lessons enable the knowledge to be grasped more easily (Çömlekçioğlu & Bayraktaroğlu, 2001). In studies on new curricula in Turkey, teachers' opinions are frequently encountered regarding "significant disruptions in the implementation of the curricula due to the lack of structures, tools, materials and materials" (Akça, 2007, Peker & Halat, 2008; Şahin, 2010). Model teaching method; It is a teaching method applied with the help of examples of real objects made of the same or other material, and objects brought to the classroom from their natural environment (Çilenti, 1985).

In our project, the teaching material describing the structure and function of the Nephron, which performs the filtration-reabsorption-secretion function in the kidney, which is one of the subjects of the 11th grade biology course, excretory system unit, was designed with the "material development method". Chipboard and Styrofoam were used for the background of the nephron model. For the demonstration of the nephron canal, a PVC pipe with a diameter of 2 cm and a length of 155 cm, which is used for plumbing, was used. A transparent tube with a diameter of 1 cm and a length of 220 cm was used for blood vessel display in the nephron model. In order to ensure the movement of blood in the transparent tube, the aquarium in a container filled with red acrylic paint placed at the back of the nephron model was moved with the help of an internal filter motor. Glomerulus capillaries with glass sugar bowl and transparent tube filled with red acrylic paint were shown in Bowman capsule design to demonstrate infiltration in Malpighi corpuscle. Transparent tubes and syringes filled with acrylic paint were used to symbolize the parts of the nephron where absorption and secretion from the blood occur (Proximal tube, descending and ascending limb of Henle, Distal tube and urine collection duct). In addition, the functions of the parts of the nephron, showing blood flow, were pasted on the Styrofoam as notes.

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