

EXTENDED WORKSHEET DEVELOPED ACCORDING TO 5E MODEL BASED ON CONSTRUCTIVIST LEARNING APPROACH

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ABSTRACT

In order to achieve the targeted objectives desired level of education and modern learning theories for learner-centered methods are recommended. In this context the use of worksheets developed and that student participation is considered to be one of the methods. This research is one of the ethyl alcohol fermentation biology issues and prepare working papers related to the effective education environment was conducted to determine the effect of learning the use of worksheets. Worksheets development process to experts in the field of material in order to developed, four teachers from working in the province of Trabzon. Curriculum subject and the subject determined by considering the behavior of the target sample selected as an achievement test was developed and Bayburt Education Faculty of Bayburt University science education to about 28 students that 2 grade. Later, the interviews with teachers, and achievement test results utilizing "ethyl alcohol fermentation" A study on the leaf has been drafted. At the same teachers which prepared the necessary corrections were made in the drafts discussed the applicability of learning environments. The worksheet is applied on the sample above the spring semester of 2012. Pre-prepared students for success by developing a test applied to test parallel and compared with previous results. Student achievement is rising and the course is very relevant to the act have been identified.

Key Words: Contemporary Learning Theories, Worksheets, Ethyl alcohol fermentation, Student Success.

INTRODUCTION

It is known that many events encountered in daily life can be explained with the laws, principles, theories, concepts or facts in science. Basic science concepts have been considered as prerequisite for the understanding and explanation of subsequent science topics related to these concepts and they also take the responsibility for making sense of the associated concepts (Mann and Treagust, 2010). Therefore, it is important that these concepts should be learned correctly and significantly throughout the primary and secondary education for a good science education (Köse, Ayas and Taş, 2003). The concepts and knowledge which is skipped without learning correctly affect the education life of the individuals and also they cause the individuals to encounter greater understanding and cognitive problems in their daily and professional life (Schulte, 2001). Although many concepts in daily life and events are related to science, students have difficulty in associating nearly the entire events related to these concepts with daily life (Töman, 2011). Therefore, they underachieve in many

cases and they construct many concepts wrongly (Çepni, 2005). Biology is one of the courses in science content areas which often includes many misconceptions due to consisting of abstract topics (Konuk and Kılıç, 2002). One of the topics which students underachieve and misconceive in biology is ethanol fermentation (Yip, 2000). Ethanol fermentation topic has an important place in biology curriculum and a connection to daily life.

It is known that students have a lot of misconceptions about fermentation and they are not able to associate the cases and events with daily life (Anderson, Sheldon and Dubay, 1990; Sanders, 1993). During the implementation of constructivist learning approach in classrooms, it is indicated that learning environments where students can actively participate and explore, extend/elaborate, and evaluate any cases or events they encounter by using their own ideas must be prepared (Coştu, Karataş and Ayas, 2003). However, there is a need for materials which will guide the students to learn the core knowledge more actively, pay attention to misconceptions and promote more effective concept learning (Atasoy and Akdeniz, 2006). Therefore, the 5E model of constructivist approach was developed to minimize the misunderstandings of the students and help them associate school knowledge with daily life and it is known that many materials appropriate to this model have been developed and implemented (Şahin and Yıldırım, 1999). Conceptual change texts, concept maps, analogy and such materials are usually used in the studies which especially aim at eliminating misconceptions of the students (Turgut and Gurbuz, 2012). Worksheets are one of the teaching methods which can be done individually or in group work and enable conceptual development (Saka, Akdeniz and Enginar, 2002).

Worksheets are written materials consisting of individual activities which the students will do while learning a topic and also will enable the students to take responsibility for their own learning with the given process steps related to these activities (Michaelis and Garcia, 1996; Kurt, 2002; Çakır, 2004). Worksheets are frequently used by the teachers and the students. There are studies which reveal that worksheets enhance student interest in the lesson and have qualities which affect success positively (Kurt and Akdeniz, 2002; Özmen and Yıldırım, 2005). Moreover, it is suggested that teachers should use student-centred contemporary teaching methods to increase student interest and success in biology consisting of important topics related to daily life such as ethanol fermentation and to raise potential scientists who want to improve themselves in this field (Birbir, 1999).

It is a known fact that special materials are required in secondary education in terms of subjects (Yürük and Çakır, 2004). The aim of this study is to reveal the effect of worksheets developed about ethanol fermentation according to the 5E model of constructivist theory on student success.

PURPOSE

The aim of this study is to prepare effective worksheets about ethanol fermentation, a topic in a unit called "Energy Transformation in Living Organism" in biology course, according to the 5E model of constructivist theory and identify the effects of the use of worksheets on learning in education environment.

METHODOLOGY

The opinions of four teachers who are experts in their field and working in Trabzon were taken with the purpose of developing materials during the development process of worksheets. An achievement test was developed by taking into consideration the goals and objectives of the topic chosen in the curriculum and the test was given to the 28 students in the second year of their studies in Science Teaching Department of Bayburt Education Faculty in Bayburt University chosen as sampling of the study. Then a worksheet draft called "Ethanol Fermentation" was prepared by benefiting from the results of the interviews carried out with the teachers and the achievement test. The applicability of the drafts prepared in learning environments were discussed with the same teachers and the necessary changes were made. The worksheet was implemented on the sampling mentioned above in May, 2012 by one of the researchers of this study. Firstly, students were informed about the worksheets and their use in this process. Then, the students were informed about pre-test and the tests were distributed. After sparing enough time to answer them, the implementation of worksheets began. During the implementation each student was given a worksheet. Finally, the test which was developed

in parallel with the pre-test was given to relevant students and compared with the first results obtained. The flow diagram of this study was given in Figure 1. Moreover, the findings obtained from the analysis were presented in the next part of the study.

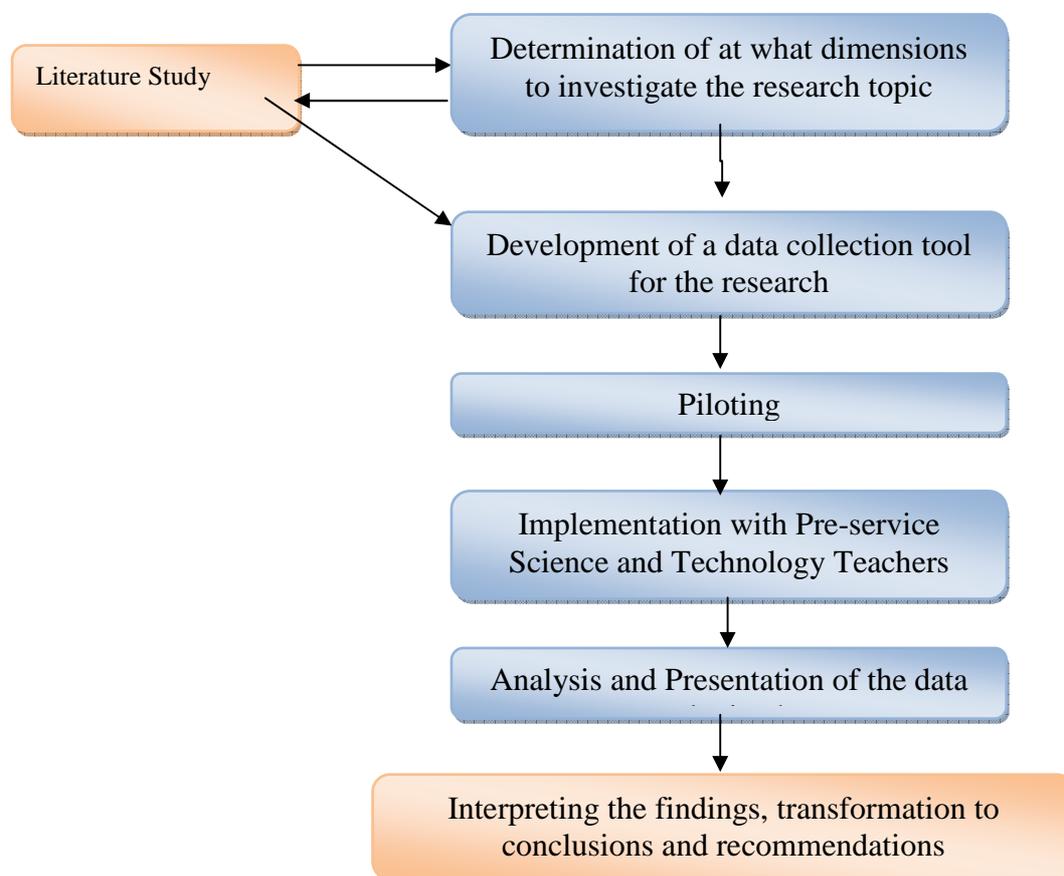


Figure 1: Flow diagram of the study

FINDINGS

The data in this section were grouped under three headings. While teacher opinions were given during the process of materials development in the first part, a worksheet developed according to the 5E model of constructivist theory was given in the second part. In the third part, the results of the parallel tests done by the students were compared.

Teacher Opinions during the Material Development Process

The opinions of the expert teachers in the field and educational and content suitability of the worksheet developed about Ethanol Fermentation according to the 5E model of constructivist approach in order to determine its visual suitability were presented in Table 1.

Table 1: Teacher Remarks

Teacher responses	Teacher
<i>The content is up-to-date.</i>	T3
<i>The explanations made in the material are adequate.</i>	T1, T4
<i>There are no spelling mistakes and incoherency in the material.</i>	T3
<i>It has a quality which activates the student..</i>	T1, T2
<i>The material is motivating in terms of education.</i>	T2

<i>The material is remarkable in terms of education.</i>	<i>T1, T2, T3, T4</i>
<i>The material does not have time constraint.</i>	<i>T2, T3</i>
<i>The colours used in the material design are compatible.</i>	<i>T3, T4</i>
<i>The material is simple .</i>	<i>T1, T4</i>
<i>The material is compatible with the gains.</i>	<i>T1, T2</i>
<i>The material serves its purpose.</i>	<i>T2, T3, T4</i>

While the findings obtained were presented in Table 1, some abbreviations were used. What these abbreviations refer to were given below. For example, T1 represents the first teacher whose opinion was taken, R symbolizes the researcher.

- R: What are your opinions about the material?

- T2: There is a parallelism between the gains determined and the content of the material. I believe that the material will be effective.

- R: Evaluate the material in terms of its visual quality

- T4: When I look at the material, what draws my attention is that there are colours and cartoons which can interest the students. Moreover, the material does not strain the eyes, so it looks positive.

- R: Evaluate the material in terms of its educational suitability.

- T1: In my opinion, the material will be useful for the students because when a student uses the material, s/he can actively participate. Moreover, the material is not bad in terms of education.

Necessary changes were made by benefiting from the teacher opinions and the worksheet was finalised.

Findings Obtained from the Students' Achievement Tests

True/ False questions in the achievement test given to the students before the worksheets and which gains they aim at testing were presented in Table 2. Because the post-test questions prepared were parallel with the pre-test questions, they were not specified again.

Table 2: True –false questions belonging to the achievement test and the gains intended to be developed

TRUE-FALSE QUESTIONS	BEHAVIORS
<i>Fermentation is a chemical decay of material.</i>	<i>Define fermentation.</i>
<i>As a result of fermentation water and carbon dioxide is formed.</i>	<i>It explains the products which enter and leave reaction in ethanol fermentation.</i>
<i>Oxygen is used in place of carbon dioxide in fermentation.</i>	<i>It explains the formation of ethanol and carbon dioxide from glucose in anaerobic respiration.</i>
<i>Mushrooms both aspirate oxygen and ferment in an environment where there is oxygen.</i>	<i>It explains the conditions required for ethanol fermentation.</i>
<i>Fermentation is used in the production of many different nutrients. Yoghurt, boza, alcoholic drinks are some of the nutrients produced via fermentation.</i>	<i>It associates fermentation with daily life.</i>
<i>Fermentation is an important biochemical process which generates ATP (Adenosine-triphosphate) via glucose..</i>	<i>A general evaluation is carried out about the gains obtained so far.</i>

The results of true/ false tests given to the students before and after the worksheets were evaluated and their responses to the questions were presented in Table 3.

Table 3: Students' responses to the questions

Question number	PRE-TEST			POST TEST		
	Number of True Answers	Number of False Answers	Number of Blank Answers	Number of True Answers	Number of False Answers	Number of Blank Answers
1	19	8	1	24	4	-
2	3	24	1	18	9	1
3	4	23	1	21	7	-
4	17	10	1	22	5	1
5	25	-	3	28	-	-
6	12	13	3	28	-	-

As shown in Table 3 when the question which aimed at describing fermentation process is examined according to the responses given before using the worksheets, it is understood that more than half of the students answered correctly. It was revealed that after the worksheets were implemented, the number of students who answered correctly increased.

It is regarded that the number of correct responses given by the students before the implementation for the second question which aimed at explaining the products which enter and leave the reaction in ethanol fermentation was rather low. However, it is regarded that the number of correct answers given by the students increased prominently after the activities done in the worksheets. It is determined that as in the second question the number of correct responses given by the students was rather low for the third question which aimed at explaining the formation of ethanol (ethyl alcohol) and carbon dioxide from glucose in anaerobic respiration. It is understood that nearly all of the students gave correct responses after the implementation.

In the fourth question which aimed at explaining the conditions required for ethanol fermentation, more than half of the students gave correct responses. It was revealed that the number of students who gave correct responses clearly increased after the activities carried out.

In the fifth question which aimed at explaining ethanol fermentation which students encounter in daily life, it is determined that nearly all of the questions gave correct responses before the activity. This contributed to the rise of correct answers with the activities based on worksheets. In the last question which aimed at asking the students to make a general evaluation about the gains, it is determined that when compared to before the activity the number of correct responses given by the students increased more than a hundred percent.

RESULTS AND SUGGESTIONS

It is a known fact that worksheets activate the students more and they usually increase success. A study was carried out in this research with the aim of evaluating worksheets while teaching ethanol fermentation which was prepared according to constructivist approach. It is also a known fact that the behaviour which individuals learn by trying them are more effective than the ones which they gain solely by hearing or seeing (Yalin, 2000). When the data obtained as a result of implementation of worksheets on "ethanol fermentation" in the study conducted is analysed, it is found that the rate of student success increased after the worksheets. When the questions are examined at length, higher response rates for the 5th question in the pre-test draw attention. It can be interpreted that the students must have acquired the 5th behaviour presented in Table 4.3.1 before. It is revealed from the responses given to the 2nd question in the pre-test that level of student success was rather low. It can be concluded that what the students know about the explanation of the products that enter and leave the reaction in ethanol fermentation is inadequate. However, when it is considered that this subject is an indispensable part of our daily life, the contribution of worksheets in teaching the subject becomes important. It was determined in the study that cartoons, pictures, attention-grabbing activities which are different from

traditional content and are included in the worksheets developed according to the 5E model and the links with the daily life increased student success. When the data obtained from the study is evaluated in general, it can be stated that the worksheets developed based on constructivist approach enable the students to actively participate during the learning process, help them to learn the subject better, and increase student success noticeably. Therefore, using these materials in many stages of learning can have a positive effect on teaching. Similar findings have been supported in the studies conducted by the different researchers (Nas and Çepni, 2011; Saka, Akdeniz and Enginar, 2002).

As all the students are expected to participate in the lesson and gain scientific process skills with worksheets, it is required that such studies should be carried out with the other subjects of biology. In this regard it must be ensured that worksheets developed according to contemporary learning theories are used by the teachers and the research concerning the problems encountered during this process must be conducted by using different methods.

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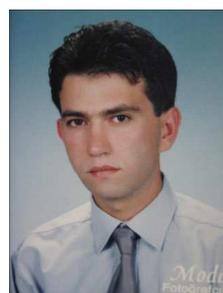
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REFERENCES

Anderson, C.W., Sheldon, T.H., & Dubay, I. (1990). "Theeffects of instruction on collegen on majors conceptions of respiration and photosynthesis". *Journalof Research in ScienceTeaching*, 27(8), 761-776.

Atasoy, Ş. & Akdeniz, A.R. (2006).Yapılandırmacı öğrenme kuramına uygun geliştirilen çalışma yapraklarının uygulama sürecinin değerlendirilmesi.*Milli Eğitim Dergisi*, 35(170), 157.

Birbir, M. (1999).Fen bilimleri eğitiminde en etkili öğretim metodunun araştırılması.*Ankara Üniversitesi Eğitim Fakültesi IV. Ulusal Eğitim Bilimleri Kongresi Bildirileri*, Eskişehir, 122-128.

Coştu, B., Karataş, F.Ö., & Ayas, A. (2003).Kavram öğretiminde çalışma yapraklarının kullanılması.*Pamukkale Üniversitesi Eğitim FakültesiDergisi*, 2(14), 33-48.

Çakır, İ. (2004). Fen Bilgisi Öğretmenlerine Ders Destek Materyali Hazırlama ve Kullanma Becerisi Kazandırmaya Yönelik Bir Çalışma. Yayınlanmamış Yüksek Lisans Tezi, KTÜ, Fen Bilimleri Enstitüsü, Trabzon.

- Çepni, S. (2005). Kuramdan Uygulamaya Fen ve Teknoloji Öğretimi, Pegema Yayıncılık, Ankara.
- Konuk, M. & Kılıç, S. (2002). Konya ili lise öğrencilerinde osmoz ve difüzyon konusundaki kavram yanlışları. V. *Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, 16-18 Eylül, ODTÜ Kültür ve Kongre Merkezi, Ankara, 22.
- Köse, S., Ayas A., & Taş, E. (2003). Fen Bilgisi Öğretmen Adaylarında Fotosentez ve Bitkilerde Solunum Konularında Görülen Kavram Yanlışlarının Giderilmesinde Kavram Değişim Metinlerinin Etkisi, *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 14, 106-112.
- Kurt, Ş. (2002). Fizik Öğretiminde Bütünleştirici Öğrenme Kuramına Uygun Çalışma Yapraklarının Geliştirilmesi, Yayınlanmamış Yüksek Lisans Tezi, Karadeniz Teknik Üniversitesi, Trabzon.
- Kurt, Ş. & Akdeniz, A.R. (2002). Fizik Öğretiminde Enerji konusunda Geliştirilen Çalışma Yapraklarının Uygulanması. *ODTÜ Eğitim Fakültesi V. Fen Bilimleri ve Matematik Eğitimi Kongresi*, 16-18 Eylül, Ankara.
- Mann, M. & Treagust, F. D. (2010). Students' conceptions about energy and the human body, *Science Education International*, 21(3), 144-159.
- Michaelis, J.U. & Garcia, J. (1996). Social Studies For Children, Eleventh Edition, Allyn Bacon. USA.
- Nas, S.E. & Çepni, S. (2011). Değerlendirme aşamasına yönelik geliştirilen çalışma yapraklarının etkinliğinin değerlendirilmesi. *Türk Eğitim Bilimleri Dergisi*, 9(1), 125-150.
- Özmen, H. & Yıldırım, N. (2005). Çalışma Yapraklarının Öğrenci Yapısına etkisi: Asitler ve Bazlar Örneği, *Türk Fen Eğitimi Dergisi*, 2(2), 124-143.
- Saka, A., Akdeniz, A.R., & Enginar, İ. (2002). Biyoloji öğretiminde duyularımız konusunda çalışma yapraklarının geliştirilmesi ve uygulanması. V. *Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi*, 16-18 Eylül, ODTÜ Kültür ve Kongre Merkezi, Ankara.
- Sanders, M. (1993). "Errorneous ideas about respiration: The teacher factor", *Journal of Research in Science Teaching*, 30(8), 919-934.
- Schulte, P. L. (2001). Pre Service Primary Teacher Alternative Conceptions in Science and Attitudes Toward Teaching Science, Unpublished Doctoral Dissertation, New Orleans University, New Orleans.
- Şahin, Y.T. & Yıldırım, S. (1999). Öğretim Teknolojileri Ve Materyal Geliştirme, Ankara: Anı Yayıncılık.
- Töman, U. (2011). Enerji Ve Enerji İle İlgili Kavramların Farklı Öğrenim Seviyelerinde Öğrenilme Durumunun Araştırılması, Yüksek Lisans Tezi, KTÜ, Eğitim Bilimleri Enstitüsü, Trabzon.
- Turgut, U. & Gurbuz, F. (2012). Effect of Conceptual Change Text Approach on Removal of Students' Misconceptions About Heat and Temperature. *Int. J. of Innovation and Learning*, 11(4), 386-403.
- Yalın, H. İ. (2000). Öğretim teknolojileri ve materyal geliştirme, (3. baskı), Ankara: Nobel Yayınları.
- Yip, D.Y. (2000). Promoting a Better Understanding of Lactic Acid Fermentation, *Journal of Biological Education*, 35(1), 37-40.
- Yürük, N. & Çakır, Ö. (2004). Lise Öğrencilerinde Oksijenli ve Oksijensiz Solunum Konusunda Görülen Kavram Yanlışlarının Saptanması, *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 18, 185-191.

APPENDIX: A Developed Worksheet

A worksheet developed about Ethanol Fermentation according to the 5E model of constructivist approach was presented below by taking into consideration the necessary stages.

Engage (Introduction)

Before giving the worksheets to the students, the students are grouped. The worksheets are given to the groups and the students' prior opinions are tried to be taken with a short story in the introduction of a worksheet and a question asked about the story. The introduction of the worksheet is given below.



One day Nasreddin Hodja buys yogurt yeas and goes to Akşehir Lake. He starts pouring yogurt in the lake. Somebody sees him and asks him:

- "What are you doing, Hodja?"

- "I'm turning the lake into yogurt" replies Hodja.

The man is surprised:

- Could it be fermented?

- I know that it won't. But what if it does?"

What is the name of the process Nasreddin Hodja tries to do in the lake? Discuss it in your group.

.....
.....
.....

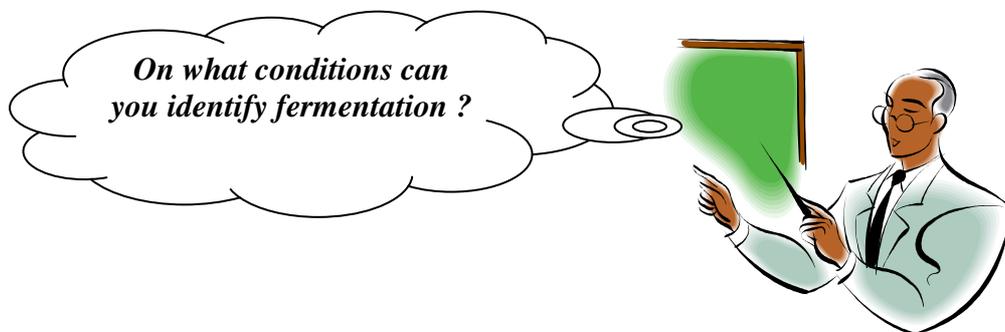
How did this process become? Discuss it in your group.

.....
.....

Explore

Before the experiment, the students are divided in five groups. In the activity of the worksheet which begins with the sentence "On what conditions can we identify fermentation?" the students try to explore how ethanol fermentation occurs and what kind of change is observed in fermentation. While the students follow the instructions in the worksheet and try to achieve a result, the teachers roam between the groups to guide the discussions and the experiment process. The students are asked to record their observations during the experiment and these observations are discussed between the groups after the experiment. The section belonging to explore in the worksheet is given below.

Do the activities given below in order to answer the questions.



Activity number 1: Fermentation

Purpose of the activity:Analyze fermentation

Required materials: A fizzy drink bottle, sugared water, a tea spoon of fresh yeast (Brewer's yeast), a baloon.

How to make the experiment:

1. Put the sugared water in a fizzy drink bottle and add a tea spoon of fresh yeast.
2. A balloon is placed around the mouth of a bottle and it is tied. It waits at a room temperature.

WHAT DID YOU OBSERVE?

Discuss in your group and explain whether there is a change with the baloon or not by giving your reasons.

.....
.....

Explain

During explanation the experiment results are compared and it is explained that ethanol and carbon dioxide is formed as a result of ethanol fermentation by coming to a conclusion. Moreover, the teacher explains the required conditions for ethanol fermentation and reminds the students the stages in fermentation process

Extend/ Elaborate

In extend/elaborate stage, the students are asked questions about different fermentation conditions apart from fermentation which occurs in experiments so that they can explain these conditions. Extend / Elaborate stage of the worksheet was given below.

Plase answer the questions below.



Why does the dough which is fermented smell? Have you ever thought about it? Discuss it in your group and explain

.....
.....

What happens when there is oxygen during the fermentation of dough? Discuss it in your group and explain.

.....
.....

What are the other circumstances where we can observe fermentation in daily life? Discuss it in your group and explain

.....
.....

Evaluate

The study is evaluated with the open-ended questions in the worksheet. The questions belonging to evaluate section were given below.

Answer the following evaluation questions below.

1. What is fermentation ?

.....
.....

2. What are the products that enter and leave the ethanol fermentation?

.....
.....

On what conditions does fermentation occur and which living organisms perform fermentation?

.....
.....