

# An Analysis of the Seventh-Grade Science Textbook in Terms of Science, Engineering, and Entrepreneurship Applications

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**Abstract:** The purpose of the present study is to analyse the secondary school 7<sup>th</sup>-grade science textbook in terms of science, engineering, and entrepreneurship applications, an area of practice emphasised in the curriculum restructured in 2018. For this purpose, the document analysis method, one of the qualitative research methods, was employed in the study. The research data source consists of 6 project design activities in the 7<sup>th</sup>-grade science textbook taught in the 2018-2019 academic year. The project design activities were analysed by content analysis. Analysis findings found coordination between the attainment of some curriculum units and the instructions in the textbook failed to be achieved. Deficiencies in terms of material, time, and cost according to science, engineering, and entrepreneurship evaluation criteria in the project design sections were also found. It was concluded that the link between the curriculum and textbook should be improved in some units following the science assessment criteria.

**Keywords:** Science, engineering, and entrepreneurship (SEE) applications, seventh-grade science textbook, project design

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## Introduction

Our world has experienced changes and developments in many areas such as the economy, technology and education over time. In the future, this development and change will reach further dimensions than it is now (Yilmaz, 2016). Living in a dynamic world in the 21<sup>st</sup> century has led to changes in individuals hierarchy of needs. It has become necessary to make some changes in our education system to raise qualified individuals following the 21<sup>st</sup>-century hierarchy of needs (Cansoy, 2018). Creating an effective learning and teaching environment and raising individuals following the requirements of the age is one of the requirements of our education system (Sungur Gul & Marulcu, 2014). 21<sup>st</sup>-century skills began to manifest themselves under the name '21<sup>st</sup> Century hierarchy of needs' in the science curriculum, which was first revised in 2017 for this purpose. Differences in the scope of skills learning can be seen in the science curriculum renewed in 2017. In the 2017 science curriculum, the skill-learning areas under three main headings were specified as scientific process skills, life skills, and engineering design skills. In contrast, these skill areas were given under the title of 'field-specific skills in the science curriculum' revised in 2018.

The changes in skill areas the last two years are a few of the studies aimed at changing the skill areas of individuals. The new age demands from individuals are based on the logic of 'design, build, and market (DBM)'. Therefore, the practices in our education system should be directed to DBM. The first signs of DBM are seen in the 2018 science curriculum. In this context, Bahar, Yener, Yilmaz, Emen, and Gurer (2018) reported that the number of attainments and lesson hours determined for the units in the science curriculum in 2018 were shortened and that SEE applications constituted a large part of the period. Accordingly, it can be claimed that the importance of engineering and design skills increased in the science curriculum in 2018. SEE applications are a strategy adopted by the curriculum. Although this indicates that engineering is at the forefront of science education, it also shows that entrepreneurship has taken its place. The presence of engineering, which is also included in the 2018 science curriculum, reveals the importance of science and engineering, with the inclusion of engineering education in the science curriculum in the USA (Sungur Gul & Marulcu, 2014). Pre-service teachers, who are aware of the importance of science and engineering, state that engineering practices are important for science education (Marulcu & Sungur, 2013).

In terms of the contribution of engineering to science education, what engineering means should be defined first. Engineering includes the object that the individual wants to design in line with their wishes and needs, its design process, and applications that are systematic and open to progress (Ministry of National Education [MoNE], 2018). On the other hand, engineering problems provide our connection with life as predicted by our education system (Ercan & Sahin, 2015). In this respect, it is similar to the problem-based learning model used in science education. Similarities

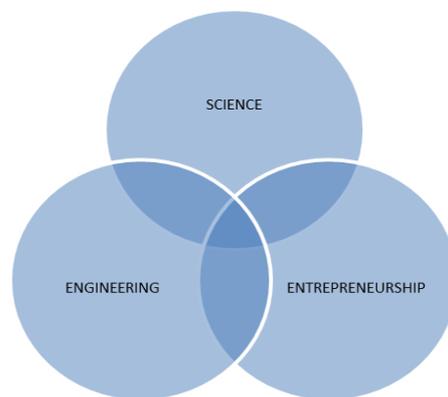
to the scientific problem-solving method were also mentioned by teachers (Sungur Gul & Marulcu, 2014).

Additionally, it was reported that engineering-based science education helps students develop many types of intelligence and skills, such as creativity, reflectivity, imagination, drawing, and scientific thinking (Marulcu & Sungur, 2013). The contribution of engineering to science education has made the creation of the 2018 science curriculum based on an innovative perspective based on science and engineering possible. Additionally, the concept of entrepreneurship, referred to as the marketing of the product obtained from the engineering design process (EDP), is also included in the 2018 science curriculum (Deveci, 2018).

It is important to develop students' marketing skills for the product they create following EDP to increase the competitive power of our country at the international level. To include entrepreneurial spirit among students' competencies, we need to know what is required from the students under entrepreneurship. MoNE (2018) emphasised that students should develop marketing strategies to introduce the products they designed to develop their entrepreneurship skills. They should benefit from promotional tools to achieve this.

### Figure 1.

*SEE Relations*

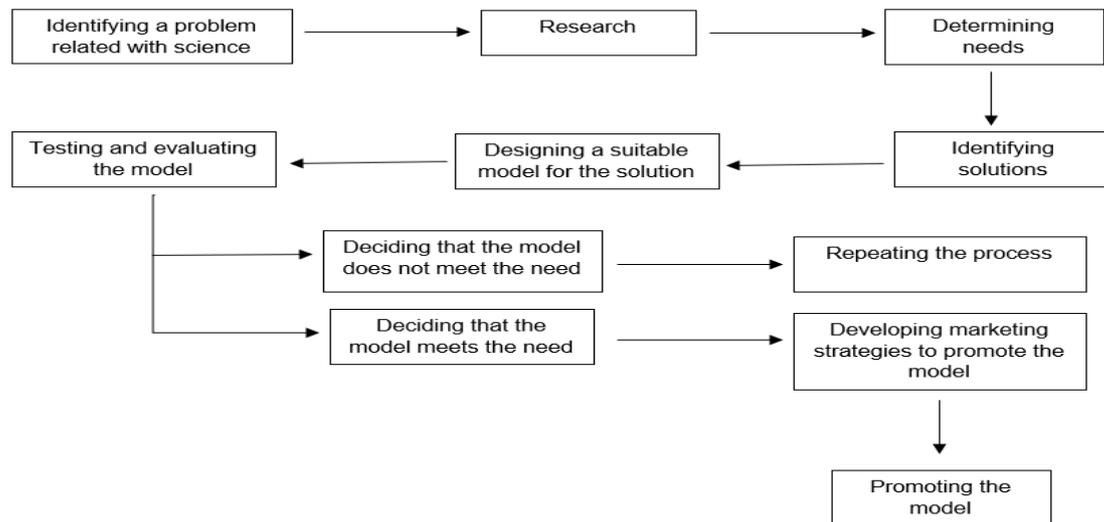


As presented in Figure 1 above, the SEE trio is presented as in the 2018 science curriculum. This relationship has been united under the name 'SEE applications' and covers students' education periods (Deveci, 2018).

Students need to experience these practices in science classes (MoNE, 2018) to increase the scientific and technological development capacity, socioeconomic development, and international competitiveness of our country within the scope of SEE practices. As a result of their engineering and entrepreneurship experiences in science classes, students can learn by actively completing the stages of designing and marketing a product. In this respect, it has a significant contribution to educating students following the requirements of the sectoral world.

Figure 2.

SEE Application Steps



As presented in Figure 2 above, students carry out the SEE applications in the science curriculum through stages. This process, which starts with determining a science-related problem, ends with introducing the model if the designed model meets the need. Students have the opportunity to introduce their model at the science festival at the end of the year (MoNE, 2018). Taken the scientific process steps and the EDP steps in the 7th-grade science textbook [written by Demirkazan, Kalik, and Ocal, (2018)], even if both contain common steps for students to create a product (model) as a result of EDP, it is essential to report the results of the data at the end of the steps (Koyunlu, Unlu, & Sen, 2018). Accordingly, science education aims to train future scientists by making students think, create a product (model), and promote this product (model) as scientists.

SEE practices have an important place in raising individuals suitable for the qualities of our age. These applications, which have a place in the science curriculum, should be included in textbooks that serve as guides for students and teachers. Textbooks approved by the MoNE should be in line with the objectives in the curriculum (Atici, Keskin Samanci, & Ozel, 2007). Science textbooks prepared following the attainments in the curriculum should help students learn with activities (Unsal & Gunes, 2003). Additionally, science textbooks organised according to students' levels (Ceger & Aydogdu, 2017) include activities that will attract students' attention and direct them to research and inquiry, which are advantages (Atici et al., 2007).

Some previous studies on science textbooks have reported that science textbooks improve students' understanding of scientific concepts (DeVore-Wedding, 2016; Guzzetti & Mardis, 2017; Lai & Chan, 2020; Lai & Wang, 2016; Romance & Vitale, 2012). Analysing textbooks (which are teaching tools for students and teachers)

according to certain criteria to prepare them according to the requirements of our dynamic world will make it easier to eliminate existing deficiencies (Koyunlu Unlu & Sen, 2018). Therefore, presenting SEE applications in textbooks will contribute to researchers, teachers, and textbook writers. For these reasons, the purpose of the present study is to analyse the activities in the 7th-grade science textbook taught in the 2018-2019 academic year in terms of SEE applications.

## **Methodology**

### **Research Model**

The present study, which analysed the 7th-grade science textbook activities taught in the 2018-2019 academic year in terms of SEE applications, employed the document analysis method. The reason for utilising document analysis is that it includes the analysis of written sources from which data can be collected about the phenomenon (Yildirim & Simsek, 2018). Depending on the purpose of the research, written sources used may be books, journals, and articles (Ozdemir, 2015).

Document analysis, which is a qualitative research method (Christensen, Johnson & Turner, 2011/2015) and a qualitative study method (such as words, pictures, and images), the permission of access is often required to access the materials (Creswell, 2007); which is among the factors that limit document analysis. However, this limitation was eliminated in the present study because a Ministry of National Education approved textbook was used.

### **Data Source and Analysis**

The 7th-grade science textbook activities taught in 2018-2019 were analysed by SEE applications in the present study. Content analysis was used to analyse the applications. Content analysis is conducted to determine certain concepts and words in the document sections to be examined (Buyukozturk, Kilic Cakmak, Akgun, Karadeniz, & Demirel, 2018).

In the 7th-grade science textbook content, there are various applications under the title 'project design' and activities. As presented in Table 1 below, the number of activities is 40, and the number of projects is 6 in the 7th-grade science textbook. While the activities create a learning environment where students will participate in the lesson and learn by completing activities, in the project design section, students are required to create projects by conducting applications that improve scientific process skills (Demirkazan et al., 2018). Therefore, there are applications in the project design section within the scope of SEE applications in the 7th-grade science textbook. Since the 7th-grade science textbook analysis in terms of SEE applications is the objective, the projects in the project design section were included in the research.

**Table 1.**

*Number of Activities and Projects in the 7th-grade Science Textbook*

Units	Number of Activities	Number of Projects
Solar System and Beyond	3	-
Cell and Divisions	4	1
Force and Energy	5	1
Pure Substances and Mixtures	8	2
The Interaction of Light with Matter	12	1
Reproduction, Growth and Development in Living Organisms	4	-
Electric circuits	4	1
<b>Total</b>	<b>40</b>	<b>6</b>

Six projects in the 7<sup>th</sup>-grade science textbook were analysed in line with the criteria determined by the researchers. These criteria were formed using the SEE application steps, and the opinions of two experts in the field were consulted to ensure validity. The steps in which three components were included in the assessment separately and the evaluation criteria prepared for SEE applications are presented in Table 2 below.

**Table 2.**

*Evaluation Criteria for SEE Applications Determined by Researchers*

<b>SCIENCE</b>	<ol style="list-style-type: none"> <li>1) Is it effective in identifying a science-related need or problem? How?</li> <li>2) Does the project design allow students to benefit from daily life?</li> <li>3) Is it directly/indirectly related to unit attainments?</li> </ol>
<b>ENGINEERING</b>	<ol style="list-style-type: none"> <li>1) Does it encourage students to research?</li> <li>2) Does it provide students with the ability to determine the need and solution path for the model to be designed/developed?</li> <li>3) Does the project topic enable students to design a suitable model for the solution?</li> </ol>
<b>ENTREPRENEURSHIP</b>	<ol style="list-style-type: none"> <li>1) Does it provide the student with marketing strategies for introducing the model? How?</li> <li>2) Does it offer the student a variety of alternatives for model promotion? How?</li> <li>3) What skills does the student develop while introducing the model?</li> <li>4) Does it enable the student to use media tools (such as the internet, newspaper, television) to promote and present the model?</li> </ol>
<b>SCIENCE, ENGINEERING AND ENTREPRENEURSHIP</b>	<ol style="list-style-type: none"> <li>1) Do the applications meet the student's goal of acquiring scientific knowledge? How?</li> <li>2) Do the applications enable the student to establish a relationship between science and engineering? How?</li> <li>3) Do the problem or need cover material, time, and cost criteria? In what way? How?</li> <li>4) Can the student integrate scientific knowledge with engineering applications and turn it into a product at the end of the application? How?</li> <li>5) Are there any explanations regarding the exhibition of the applications made at the end of the term and their presentation to the school stakeholders? How?</li> </ol>

Within the scope of the investigation, a total of 6 projects: 1 from the “cell and divisions” unit, 1 from the “force and energy” unit, 2 from the “pure substance and mixtures” unit, 1 from the “interaction of light with matter” unit, and 1 from the “electrical circuits” unit have been analysed in line with the criteria presented in Table 2 above.

## Credibility and Ethics

The study should also be taken in terms of validity and reliability to ensure credibility in qualitative research. One way to ensure reliability in a qualitative study is to provide detailed explanations of each path followed in the study (Buyukozturk et al., 2018). In the present study, all stages from data collection to the analysis process were explained and described in detail. Triangulation of the researcher was employed to increase the reliability of the data in the present study, so more than one researcher worked in the collection, analysis, and interpretation of the data.

In qualitative research, as data collection and interpretation are performed by researchers, the objectivity of the research may be disrupted. Detailed field notes can preserve the objectivity of the research (Buyukozturk et al., 2018). Field notes kept by the researchers and tables obtained from the textbook analysed provided the validity of the research.

Research ethics is a set of rules that guide the decision about researching within the framework of ethical rules. In a study in which ethical rules are followed, it is necessary to benefit from the work of others in the introduction, findings, and discussion sections (Christensen et al., 2011/2015). In this context, our research has been completed by considering research ethics. There are references to different studies in the present study.

## Findings

The analyses of the project design sections in the 7<sup>th</sup>-grade science textbook taught in the 2018-2019 academic year are presented below.

The scientific process skills in the 7<sup>th</sup>-grade science textbook are presented in Figure-3, and the engineering design process in Figures 4, 5, 6, and 7. Based on these parts of the book, the projects were evaluated.

### Figure 3.

#### *Scientific Process Skills in the 7<sup>th</sup>-grade Science Textbook*

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##### **SCIENTIFIC PROCESS SKILLS**

A scientific method is used in research projects, consisting of successive scientific steps and finding answers to the questions. When you follow the scientific method steps one by one, you will complete your project. The scientific method is a necessary tool to assist you throughout the project. In research and development projects, a model/tool that will solve a problem or do a job better is developed and tested. If you plan to conduct such projects, carefully read the instructions given under the heading "Research and Development Projects Design Process".

##### **1. Find the Project Topic**

You can start your project by determining a topic you are interested in. While determining the topic, you should also determine the research questions. The following examples can be given for research questions: How does the heart work? Why do some birds migrate? Why are cars similar in form? Why do some trees shed their leaves in autumn while others don't? What is the reason for the zinc deficiency in plants grown in the Central Anatolia

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Region? etc. If you have determined a question you want to know the answer to, you can proceed to the next step.

## **2. Research**

To answer your question, first, research the available information on the topic. You can proceed more systematically by making a research plan. You can use any written, oral, or visual materials (book, magazine, encyclopedia, brochure, internet, film, sound recording, photograph, picture, poster, etc.) related to the topic. During your research, you can meet with experts on the subject; visit places such as universities, museums, zoos, botanical gardens; you can seek support from teachers of subjects such as science, technology, and design.

## **3. Hypothesis**

Determine what you want to do, in other words, the purpose of the project, in the light of the information you have acquired on the subject. The purpose here is to define the desired result to be obtained when the project is completed. Projects usually have only one purpose. Determining the purpose helps in establishing the hypothesis. The hypothesis is "our guess for the answer to our research question". In other words, it is "the situation or situations that are likely to arise as a result of the experiment". With this aspect, the hypothesis will guide us in observations, tests, and experiments. If you have a hypothesis like "If the weather is cold, the trees shed their leaves", you build your experiment to prove this idea. You need to test the accuracy of a hypothesis such as "If it does not rain enough, plants will lack zinc" with various experiments.

## **4. Time for Experiment and Observation**

You need to design an experiment, make observations and analyses to test your hypothesis and determine whether your predictions are correct. You have to conduct the experiment you designed in a 'controlled' manner. Experiments performed by changing one of the conditions that will affect the result and keeping the others constant are called "controlled experiments". Before you start testing a hypothesis, you need to understand the concepts of "experimental group", "control group", "dependent variable", and "independent variable". For example, suppose we are investigating how effective magnets are in the growth of plants. In that case, we should examine a group of plants in a magnet-free environment while examining a group of plants together with magnets. Thus, the group in which the magnet is used becomes the "experimental group" and the other "control group". Suppose you can understand to what extent magnets affect plant growth by examining the plant growth of two groups in the same period. The variable that can be changed and thought to affect the experimental group is the "independent variable". We can choose the independent variable as we want or change it at any time. For example, the magnet is the independent variable in the plant experiment. "Dependent variable", on the other hand, is the material that changes depending on the independent variables in the experiments and can be measured. If your hypothesis is set as "plants grow faster in a magnetic environment", you need to measure the growth in plants depending on the magnet with the experiment we will do. If we determine the plant height as the growth criterion of the plant, the dependent variable will be "the height of the plant". To run your experiment properly and validly, you must change one factor while keeping all other conditions constant.

## **5. Collect and Evaluate Data**

Precise information should be gathered during the experiment. This information is called 'data'. For example, in an experiment, the water temperature is read every ten minutes, and the values are recorded, or in the magnet experiment, the change in the height of the plant is measured and recorded at equal time intervals; this is data collection. The more data we get, the better we can support or refute our hypothesis. You need to analyse the data you record during and at the end of the experiment to determine whether your hypothesis was established correctly. You can make some decisions in line with the information you have obtained due to the research. If the results do not confirm the hypothesis, this does not mean that your experiment is wrong; it shows that you should revise your hypothesis. For example, suppose you conclude that the magnet does not affect plants due to your experiments conducted to test the hypothesis that "plants grow faster in a magnetised environment"; in that case, this result means that your hypothesis is wrong. If the hypothesis is wrong, a new hypothesis is established by starting the research from the beginning. If it is found that the hypothesis was established correctly, this result may need to be tested in another way. You can report the results you have obtained with your analysis and present them at the science festival.

## **6. Report Findings**

Your poster should be well organised as it promotes the whole project and should encourage visitors to read the project. Complicated and inelaborate posters will cause the project not to be comprehended well enough. The poster should reflect the project process. The poster should consist of three main sections: preparations before the experiment, experiment process, and experiment results. The first section should explain the pre-test preparations, the second section test experiment process, and the last section the post-experiment process. In the first part, the project summary, the research question or problem considered, the hypothesis established, and the studies conducted should be written. In the second part, the project's name, the materials used, the procedures applied, and the analysis should be included. The findings and evaluation should be in the last section. Suggestions for future studies and expected studies can also be written here.

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Figure 4.

Process Steps in the 7th-grade Science Textbook

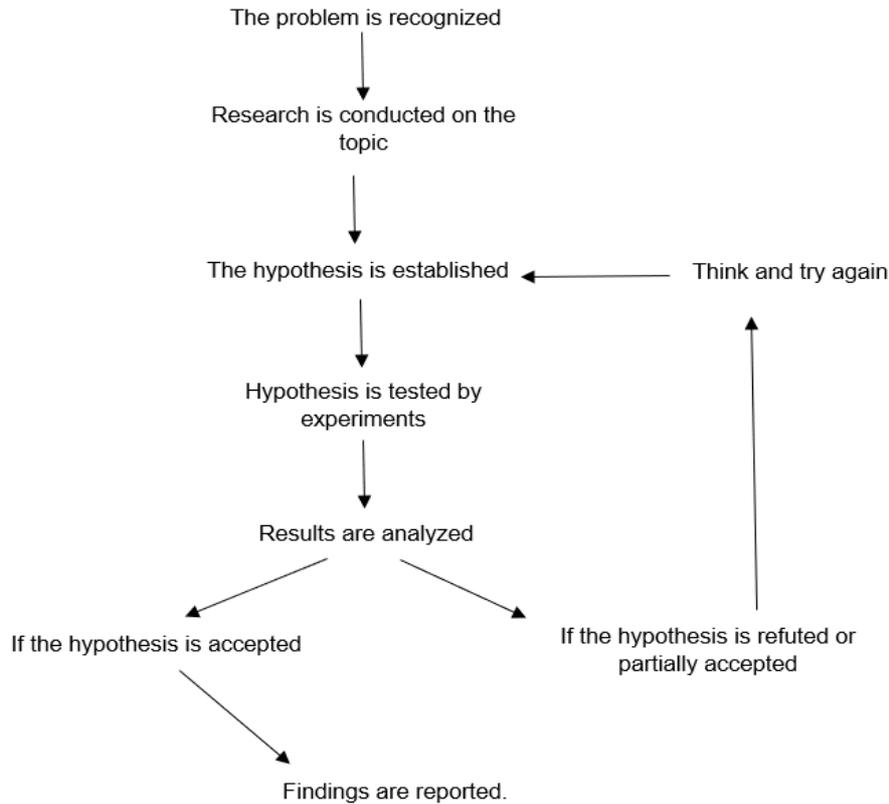


Figure 5.

Engineering Design Skills in the 7th-grade Science Textbook

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**ENGINEERING DESIGN PROCESS**

If your project involves inventing a new model/tool, designing or developing an existing model/tool, you can follow the process of research and development project design.

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**1. Define the problem.**

The research and development project begins by asking the following questions about the problems you see:

- WHAT? What is the problem or what is needed?
  - WHO? Who has a problem or who needs it?
  - WHY? Why is it important to solve this problem?
- 

**2. Research.**

For a research and development project, you should review the work others have done in that field and learn from their experiences. You should research two main areas:

- Who are the users and customers of the existing or potential product?
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- What are the available solutions?

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**3. Define the requirements.**

Defining your design requirements is the most important step for your solution to the problem to be successful. To define the requirements, you should analyse the key features of existing solutions similar to the target design.

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**4. Create alternative solutions.**

There are multiple ways to solve design problems. If you focus on just one solution, you might miss another way that will provide you with a better solution. A good designer tries to find more than one solution.

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**5. Choose the best solution.**

You should check whether the solution alternatives you find meet the design requirements. Some solutions probably meet more requirements than others.

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**6. Improve the solution.**

It would be best to improve and develop your solution throughout the design process (even after the product has been launched).

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**7. Build a prototype.**

A prototype is the first sample that emerged in the process of solving the problem. Usually, simpler materials are used in building them, and they are made to test how the final product will work. It is an important step in the development of the end product.

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**8. Test your solution.**

Define the problems in running the solution by testing the solution you found, test again after you make the necessary changes. This way, you will have eliminated all the problems before presenting your final design.

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**9. Report the findings**

To complete your project, you must share your findings. After the model/tool is completed, a report should be written, presenting what has been done in the process. In addition to presenting the products by exhibiting them, summarise the project process with a poster.

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**Figure 6.**

*Project Sample in the 7th-grade Science Textbook*

**PROJECT SAMPLE**

Project name:

The purpose of the project:

The goals of the project:

Resources used in the research:

Materials/tools used:

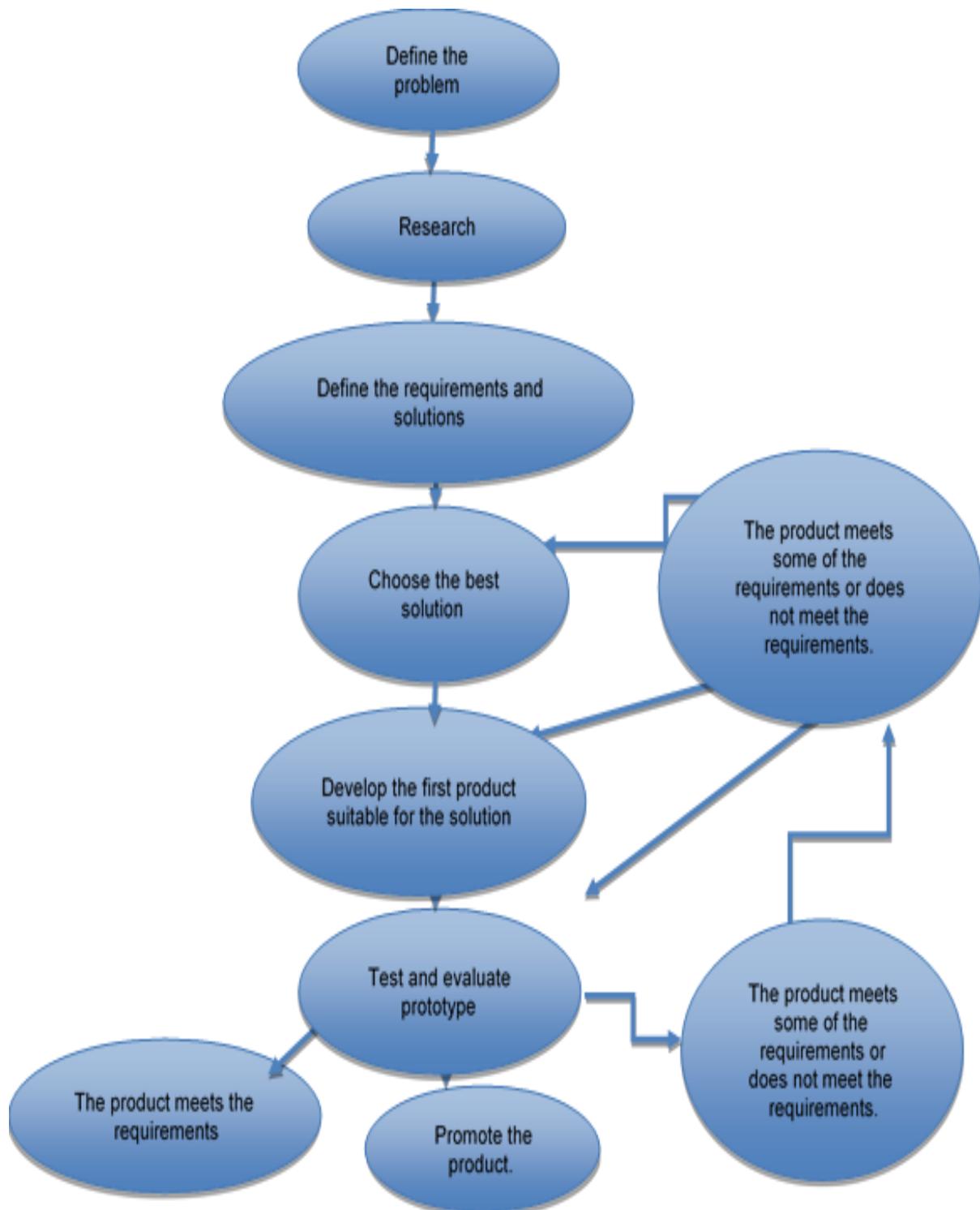
Summary of the project or design:

The finding obtained :

Drawing of the design:

Area for drawing of the design:

Figure 7.  
Engineering Design Process



Based on the analysis of the six project designs in the 7th-grade science textbook, according to the determined criteria, it was found that engineering, entrepreneurship, and SEE parts have common aspects in all projects in the book, even when the project topics are different. The common parts found in the project design sections are presented in Table-3 below.

**Table 3.**

*Common Points of Engineering, Entrepreneurship, and SEE Assessment Criteria for the 6 Projects*

Descriptions	
<b>Engineering</b>	<p>According to the statement "... prepare your project using the scientific process and design steps..." (Demirkazan et al., 2018, p. 72), it can be concluded that students are knowledgeable of the research steps while preparing their projects.</p> <p>Since the project design is left to the imagination and creativity of the student, the solution method and needs recognition for the model are considered skills that the students can gain through experience.</p>
<b>Entrepreneurship</b>	<p>The statement in the project description section, "... Prepare an impressive promotion (such as preparing a newspaper, internet, television advertisement) for the presentation of your product." (Demirkazan et al., 2018, p.72) shows that students are offered various alternatives to introduce the model. Students are free while choosing the marketing method. According to the textbook's project design section, while various alternatives are offered for students to introduce the products they have designed, marketing strategies are not included. However, it is believed that students will learn these marketing strategies by experience in the science festival at the end of the year.</p> <p>According to the instruction, "... Keep your project until the end of the year to present it at the "End of Year Science Festival" at the school. Prepare an impressive promotion (newspaper, internet, television advertisement, etc.) for the presentation of your project." (Demirkazan et al., 2018, p.146), students are asked to present the model they have created using various media tools such as the newspaper, internet, and television advertisements at the end of the year science festival.</p> <p>Anagun and Atalay (2017) state that an individual with entrepreneurial skills, one of the sub-dimensions of 21<sup>st</sup>-century skills, has personality traits such as being open to innovations, productive, active thinking, and risk-taking. It is believed that students will develop entrepreneurship skills within the scope of science, engineering, and entrepreneurship practices during the year.</p> <p>It will be beneficial for students to acquire skills such as communication, entrepreneurship, cooperation, flexibility, and adaptability by performing various tasks within the scope of science, engineering, and entrepreneurship applications.</p>

According to the instruction in the project section, "... Prepare your project using the project sample on pages 14, 15, 16 and 17, scientific process and design steps..." (Demirkazan et al., 2018, p.72), it can be concluded that students will obtain scientific knowledge by using their scientific process skills and design steps through their experiences. Additionally, EDP is included in the textbook after the scientific process skills (SPS) (Demirkazan et al., 2018). Therefore, it can be concluded that the steps that students will follow in this process help them establish a relationship between science and engineering.

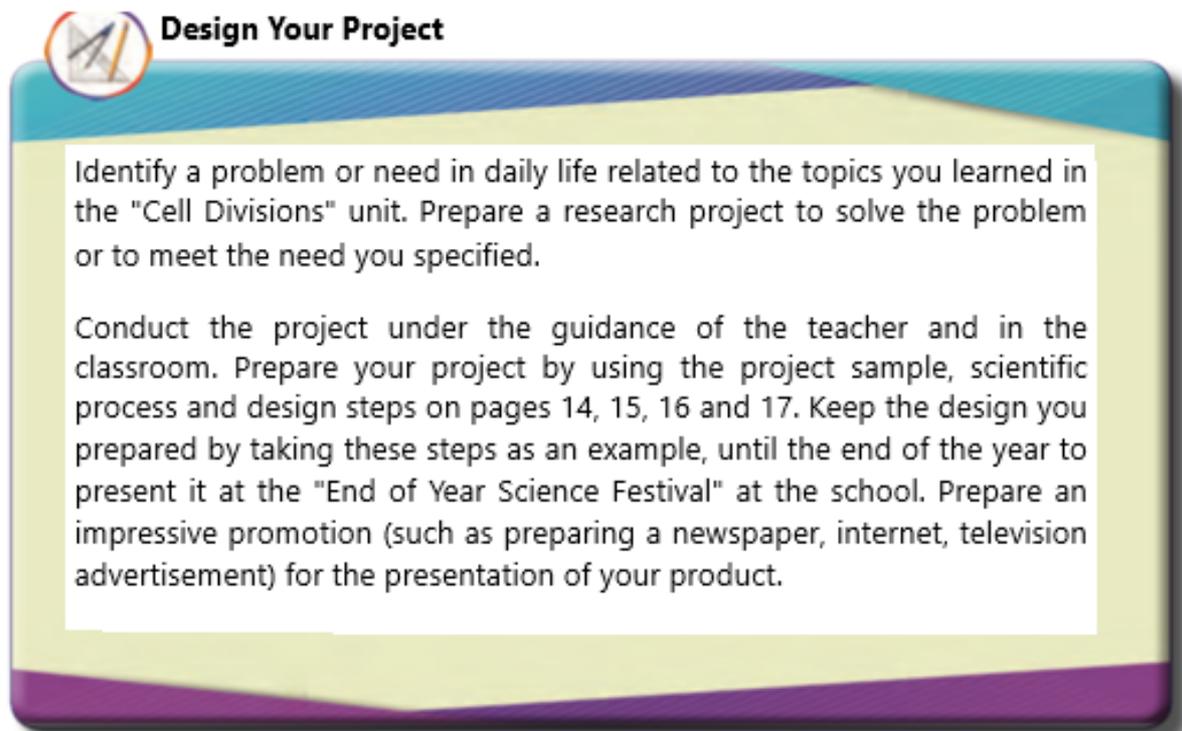
The instruction in the project description section "... keep your design/project until the end of the year to present it at the "End of Year Science Festival" to be held at the school." (Demirkazan et al., 2018, pp.72, 146, 149, 186, 231), indicates that the products designed will be exhibited and presented at the end of the term.

Step "7. Create a prototype" in the EDP on page 16 of the textbook is believed to contribute to students' transformation of scientific knowledge into products by integrating it with engineering applications.

There are no warnings related to material, time, and cost criteria in the project design section. However, the step in EDP on page 16 of the textbook, "3. Determine the Requirements", indicates that the characteristics of similar studies should be analysed to solve the specified problem.

## Figure 8.

Project in Unit 2: "The Cell and Divisions" (Original figure is in appendix 1)



**Design Your Project**

Identify a problem or need in daily life related to the topics you learned in the "Cell Divisions" unit. Prepare a research project to solve the problem or to meet the need you specified.

Conduct the project under the guidance of the teacher and in the classroom. Prepare your project by using the project sample, scientific process and design steps on pages 14, 15, 16 and 17. Keep the design you prepared by taking these steps as an example, until the end of the year to present it at the "End of Year Science Festival" at the school. Prepare an impressive promotion (such as preparing a newspaper, internet, television advertisement) for the presentation of your product.

**Table 4.***Findings on Project in Unit 2: "The Cell and Divisions"****In terms of the science assessment criterion***

The instruction in the project description, **"Identify a problem or need in daily life related to the topics you learned in the unit of "Cell divisions". Prepare a research project to solve the problem or meet the need..."** (Demirkazan et al., 2018, p.72), indicates that it is effective in determining a need or problem related to science. Additionally, the emphasis on choosing this need and problem from daily life shows that students can benefit from daily life in project design.

It has been observed that there is no attainment regarding project design in the attainments of the "cell and divisions" unit in the 2018 science curriculum. Therefore, it is thought to be indirectly related to unit attainments.

***In terms of the engineering assessment criterion***

For the topic of the project, students are asked to create a research project on cell divisions. Since the project should follow the steps on pages 14, 15, 16, and 17, it was observed that this creates ambiguity in the type of project required for this unit. At this stage, students can continue the project process under the teacher's guidance and be active in the research project.

**Figure 9.***Project in Unit 3: "Force and Energy" (Original figure is in appendix 2)*


**Design Your Project**

You may have seen trucks with bodies behind them on the roads. Have you ever thought about what the parts on the cabs of these trucks that stand at an angle are for? Truck bodies are usually made higher than the truck cab to carry more load. This causes the body to be affected more by the air resistance and the movement of the truck becomes more difficult. An angled part added to the truck cabs changes the direction of the wind coming to the body while the truck is moving. Thanks to this simple solution, the air resistance affecting the truck is reduced. Therefore, fuel consumption is reduced.

Some living creatures have natural features that reduce the air and water resistance in their environments. It is a common method to be inspired by the creatures in nature to reduce air and water resistance. For example, fish are taken as an example for a submarine design and birds for a high-speed train design. In this way, the natural features of some living creatures are transferred to technological designs.

Design your own vehicle similar to these vehicles designed by engineers to reduce air and water resistance. Conduct the project under the guidance of the teacher and in the classroom. Prepare your project by using the project sample, scientific process and design steps on pages 14, 15, 16 and 17. Keep the design you prepared by taking these steps as an example, until the end of the year to present it at the "End of Year Science Festival" at the school. Prepare an impressive promotion (such as preparing a newspaper, internet, television advertisement) for the presentation of your product.

Table 5.

*Findings on Project in Unit 3: "Force and Energy"*

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*In terms of the science assessment criterion*

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In the project description section, a problem that can be encountered in daily life "... **This situation causes the body to be affected from the air resistance more and the movement of the truck becomes difficult...**" (Demirkazan et al., 2018, p.103) and its solution are presented. Additionally, the sample case "... **the natural characteristics of some living organisms are transferred to technological designs...**" (Demirkazan et al., 2018, p. 103) shows that nature is a source of inspiration for technological designs. Giving examples of situations that can be encountered in daily life at the beginning of the project design shows that students recognise a need or problem in daily life and find a solution. This is directly related to the attainment "F.7.3.3.3. Designs a tool to reduce the effect of air or water resistance." in the 2018 science curriculum.

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*In terms of the engineering assessment criterion*

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Project topic enables students to develop a suitable model for the solution. Since 'force and energy' is a more effective unit for students to learn with models and experiences, it is thought that it enables them to design products suitable for the solution.

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*In terms of SEE assessment criterion*

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Step "7. Create a prototype" in EDP on page 16 of the textbook is thought to contribute to the students' transformation of scientific knowledge into products by integrating them with engineering applications. However, according to the F.7.3.3.3 attainment sub-item "**b Designs are created by drawing, they are not transformed into a three-dimensional product**" in the 2018 science curriculum indicates that students are not expected to transform their designs into three-dimensional products.

Although the instruction in the project description section "... **keep your design until the end of the year to present it at the 'End of Year Science Festival ...**" (Demirkazan et al., 2018, p. 103) indicates that designed products are expected to be exhibited and presented at the end of the year, a three-dimensional product is not required by the attainments. Implying that students are expected to introduce their designs, which they produce only by drawing, in this process.

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Figure 10.

1<sup>st</sup> Project in Unit 4: "Pure Substances and Mixtures" (Original figure is in appendix 3)


**Design Your Project**

1 liter of waste oil can pollute 1 million liters of water. Studies are conducted to collect and recycle waste vegetable oils that cause clogging of sewage lines, increase the operating cost of treatment plants, and harm the environment and human health. Within the scope of the "Zero Waste Project" supported by the Ministry of Environment and Urbanization, a district municipality that works for the collection and recycling of waste vegetable oils has facilitated this process by placing vegetable waste oil collection machines in different parts of the city. Waste oils, which were previously collected by vehicles by going to houses by the environmental police, are now collected in these machines. The machines inform the citizens about the actions to be taken before pouring the oil with an audio warning system. Citizens come to these points and pour the waste oil from the compartment on the machine and earn points according to the amount of oil poured. Various gifts can be received with the points collected from the machine.

Design a "project for the recycling of domestic solid or liquid wastes" similar to this project. Conduct the project under the guidance of the teacher and in the classroom. Prepare your project by using the project sample, scientific process and design steps on pages 14, 15, 16 and 17. Keep the design you prepared by taking these steps as an example, until the end of the year to present it at the "End of Year Science Festival" at the school. Prepare an impressive promotion (such as preparing a newspaper, internet, television advertisement) for the presentation of your product.

Table 6.

Findings on the 1<sup>st</sup> Project in Unit 4: "Pure Substances and Mixtures"*In terms of the science assessment criterion*

Works carried out within the scope of the "... **Zero Waste Project...**", which is also carried out in daily life, are presented in the project description **starting with the problem of "1 litre of waste oil can pollute 1 million litres of water ..."** (Demirkazan et al., 2018, p. 146). The instruction "... **Develop a project for the recycling of domestic solid or liquid wastes**" similar to this project ... "(Demirkazan et al., 2018, p. 146) following an example of a project encountered in daily life shows that students are encouraged to identify and find a solution to a scientific need or problem they encounter in their daily life as they design their project. It is directly related to the attainment "F.7.4.5.2. Designs a project regarding the recycling of domestic solid and liquid wastes." in the 2018 science curriculum.

*In terms of the engineering assessment criterion*

According to the statement in the instruction, "... **Similar to this project...**" (Demirkazan et al., 2018, p. 146), students are expected to design a project that can create a solution to the problem they have defined by taking the project example as a reference while choosing their project topic. For this reason, the topic of the project is suitable for students to design an appropriate model for the solution.

Figure 11.

2<sup>nd</sup> Project in Unit 4: "Pure Substances and Mixtures" (Original figure is in appendix 4)


**Design Your Project**

Antalya - Konyaalti Municipality has implemented a project that will prevent the used clothes from being thrown away and recycle them. The purpose of the "If You Don't Wear It, Let It be Worn Project" by Konyaalti Municipality is to deliver unused clothes to those in need quickly and easily. Another purpose is to recycle the clothes and shoes that cannot be used and to bring them into the economy. Within this scope, "Used Clothes and Shoe Boxes" were placed at 200 different points. Konyaalti Municipality officials said: "Our citizens will now be able to leave their clothes, shoes, bags or all kinds of textile products in these boxes. After the collected clothes are separated and cleaned, some of them will be delivered to the citizens in need living in Konyaalti through our Directorate of Culture and Social Affairs, and the other part will contribute to the economy by recycling. The number of these boxes will also be increased based on demand. With this campaign, our citizens will also be able to make use of their unused belongings."

Design a project of your own "for the delivery of reusable items to those who need it", similar to the project conducted by Konyaalti Municipality.

Conduct the project under the guidance of the teacher and in the classroom. Prepare your project by using the project sample, scientific process and design steps on pages 14, 15, 16 and 17. Keep the design you prepared by taking these steps as an example, until the end of the year to present it at the "End of Year Science Festival" at the school. Prepare an impressive promotion (such as preparing a newspaper, internet, television advertisement) for the presentation of your product.

Table 7.

Findings on the 2<sup>nd</sup> Project in Unit 4: "Pure Substances and Mixtures"**In terms of the science assessment criterion**

Based on the purpose given in the project description, "... **The aim of the Konyaalti Municipality's 'If You Do Not Wear, Let it be Worn Project' is to deliver unused clothes to the needy quickly and easily ...**" (Demirkazan et al., 2018, p. 149), a need related to recycling is explained by giving examples from daily life. Within this scope, the topic of the project meets a daily problem or need related to science.

It is directly related to the attainment "F.7.4.5.5. Develops projects to deliver reusable items to those in need.." in the 2018 science curriculum.

**In terms of the engineering assessment criterion**

With the instruction for choosing the topic of the project, "... **Similar to the project of Konyaalti Municipality, you also develop a project of your own "for delivering reusable goods to those in need"**" (Demirkazan et al., 2018, p. 149), students are expected to design a project that can create a solution to the problem they have defined by taking the project sample as a reference. For this reason, the topic of the project is suitable for designing a solution-oriented model.

Figure 12.

## Project in Unit 5: "The Interaction of Light with Matter" (Original figure is in appendix 5)



## Design Your Project

Anton van Leeuwenhoek was born the son of a basket maker. At the age of 16, he apprenticed with a fabric merchant. He first became interested in simple magnifiers during those years. He continued to be interested in lenses after starting his own fabric business. Familiarity with the glass business made it easy for him to deal with lenses. Microscopes of that time had 20- or 30-times magnification. However, these magnification rates were not sufficient for research. There were also technical difficulties in producing them. Anton van Leeuwenhoek sought ways to manufacture his own microscope to make simple observations. He bought a copy of Robert Hooke's book, which describes his observations with the microscope. This book facilitated his research on microscopes. Later, Van Leeuwenhoek started developing his own microscope. Thanks to his knowledge of the lenses and his determination to work, he was able to achieve a magnification rate of more than 200 times.

Van Leeuwenhoek's design consisted of a single lens mounted through a small hole in a metal plate. Its position and focal point were adjusted by turning the two screws. Only the 8-10 cm long microscope had to be held close to the eye, requiring very good lighting and patience. Anton van Leeuwenhoek was the first to observe and identify microscopic creatures using his own handmade microscopes.

Van Leeuwenhoek designed an imaging tool using lenses. Use a lens (thin-edged, thick-edged), mirror (flat, hollow, bumpy) or other materials to design an "imaging tool" for your needs. First of all, you need to express your design to solve a problem or improve an existing tool with drawing. Conduct the project under the guidance of the teacher and in the classroom. Prepare your project by using the project sample, scientific process and design steps on pages 14, 15, 16 and 17. Keep the design you prepared by taking these steps as an example, until the end of the year to present it at the "End of Year Science Festival" at the school. Prepare an impressive promotion (such as preparing a newspaper, internet, television advertisement) for the presentation of your product.

Table 8.

## Findings on Project in Unit 5: "The Interaction of Light with Matter"

*In terms of the science assessment criterion*

Anton van Leeuwenhoek's story of developing his microscope is presented in the project description with the statement, "... **The microscopes made up to that time had a magnification of 20 or 30 times. However, these magnifications were not sufficient for research. There were also technical difficulties in producing them. Anton van Leeuwenhoek sought ways to develop his own microscope to make simple observations...**" (Demirkazan et al., 2018, p. 186). The statement "... **Van Leeuwenhoek designed an imaging tool using lenses...**" (Demirkazan et al., 2018, p. 186) shows students that they can benefit from daily life in solving a problem related to science. Accordingly, it is concluded that students are encouraged to benefit from daily life in solving a science-related need or problem by referring to the sample situation at the beginning of the section.

It is directly related to the attainment "F.7.5.3.5. Designs an imaging tool using mirrors or lenses." in the 2018 science curriculum.

*In terms of the engineering assessment criterion*

With the statement in the description about defining the needs of the project and reaching a solution, "...**Design a similar "imaging tool" for your needs by using a lens (thin-edged, thick-edged), mirror (flat, hollow, bump) or other materials...**" (Demirkazan et al., 2018, p.186), students are expected to design an original project by taking the project example as a reference. For this

reason, the topic of the project is suitable for students to design a solution-oriented model.

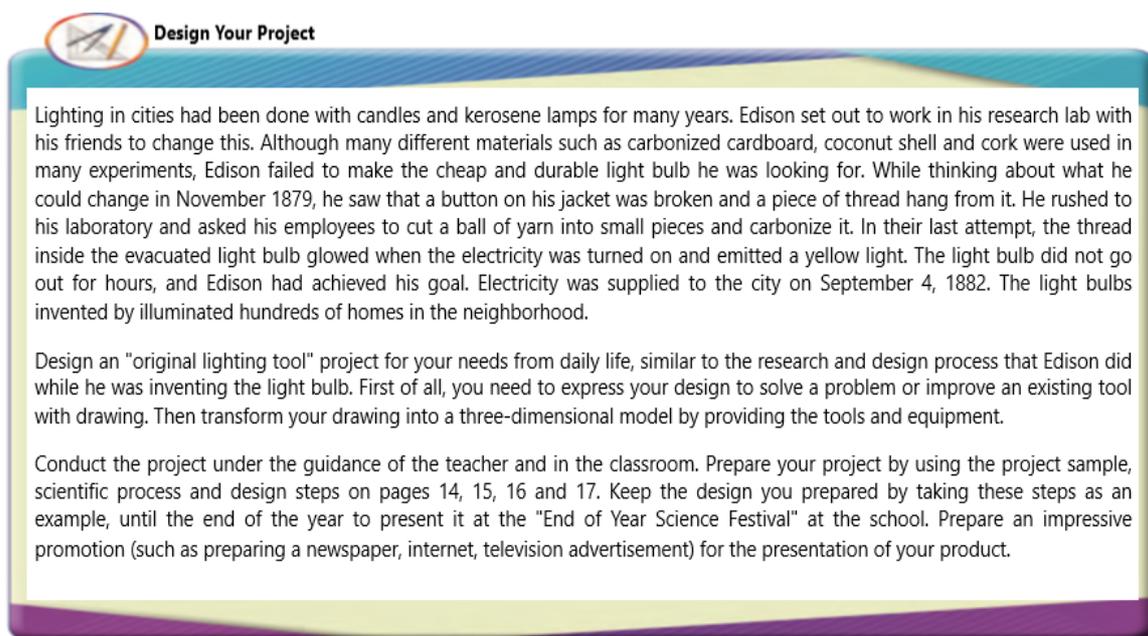
**In terms of the SEE assessment criterion**

The statement in the project design section, “... **by using a lens (thin-edged, thick-edged), mirror (flat, hollow, bump) or other materials...**” (Demirkazan et al., 2018, p.186), is an instruction for students to design projects using other materials. The statement “... **if means are available...**” in the MoNE 2018 science curriculum shows that the project is based on implementing the material, time, and cost criteria. Additionally, step “3. Define the Requirements” in EDP on page 16 indicates that to solve the specified problem, it is necessary to define the design requirements and analyse the features of similar studies. Therefore, it can be concluded that the curriculum and the instructions in the textbook are in agreement.

Step “7. Create a Prototype” in EDP on page 16 of the textbook is believed to help students integrate scientific knowledge with engineering applications and transform them into products. However, with the statement in the 2018 science curriculum, “**First of all, students expected to express their design with drawing. If the means are available, they may be asked to transform it into a three-dimensional model.**”, students are expected to transform their designs into three-dimensional products in line with the possibilities. In the textbook, there is an instruction stating hat “... **you need to express your design with drawing first...**” (Demirkazan et al., 2018, p. 186). This shows that the instruction in the textbook is in agreement with the relevant part of the curriculum.

**Figure 13.**

*Project in Unit 7: “Electric Circuits” (Original figure is in appendix 6)*



**Table 9.**

*Findings on Project in Unit 7: “Electric Circuits”*

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***In terms of the science assessment criterion***

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In the project description, Edison's adventure of inventing the light bulb is presented starting with the following statement, ***"... While thinking about what he could change in November 1879, he saw that a button of his jacket was broken and a piece of thread hung there..."*** (Demirkazan et al., 2018, p.231). With the instruction ***"... design an "original lighting tool" project for your needs from daily life, conducting a similar research and design process that Edison did while he was inventing the light bulb ..."*** (Demirkazan et al., 2018, p.231), students are encouraged to benefit from daily life in the process of identifying and solving a science-related need regarding the sample situation.

It is directly related to the attainment "F.7.7.1.6. Designs an original lighting tool." in the 2018 science curriculum.

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***In terms of the engineering assessment criterion***

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With the instruction ***"... design an "original lighting tool" project for your needs from daily life, conducting a similar research and design process that Edison did while he was inventing the light bulb ..."*** (Demirkazan et al., 2018, p.231), students are expected to design an original project regarding the project example. For this reason, the project topic is suitable for students to design a solution-oriented model.

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***In terms of the SEE assessment criterion***

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In the project design section, there is an instruction for students to obtain materials so that they can transform their drawings into products, as ***"...by obtaining the tools and equipment later..."*** (Demirkazan et al., 2018, p.231). The statement ***"... if means are available"*** in the 2018 science curriculum indicates that the project implementation is based on the material, time, and cost criteria. Additionally, step "3. Define the Requirements" states that to solve the specified problem, it is necessary to define the design requirements and analyse the features of similar studies. Therefore, the curriculum and the instructions in the textbook are in agreement.

Step "7. Create a Prototype" in EDP on page 16 of the textbook is believed to help students integrate scientific knowledge with engineering applications and transform them into products. However, with the statement given as a sub-dimension of attainment F.7.5.3.5. in the 2018 science curriculum, ***"First of all, students expected to express their design with drawing. If the means are available, they may be asked to transform it into a three-dimensional model."***, students are expected to transform their designs into three-dimensional products in line with the possibilities. In the textbook, there is an instruction stating that ***"... you need to express your design with drawing first. Then transform your drawing into a three-dimensional model by providing the tools and equipment."*** (Demirkazan et al., 2018, p. 186). This shows that the instruction in the textbook is not in agreement with the relevant part of the curriculum. While creating a three-dimensional product is optional in the curriculum, students are asked to transform their drawings into a three-dimensional model in the textbook.

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## Conclusion and Discussion

Six projects were analysed in the present study, aiming to evaluate the 7th-grade science textbook taught in the 2018-2019 academic year in terms of SEE applications. The findings indicated differences between the instructions in some textbook units and definitions in the curriculum attainments in SEE applications. According to the science assessment criterion, an agreement between the textbook and attainments cannot be achieved in the unit of "cells and divisions". While no disagreement was found in the engineering and entrepreneurship evaluation criteria, there were some lacking points regarding material, time, and cost according to SEE evaluation criteria. Additionally, there is not one SEE application for each unit.

In terms of science assessment criterion, it was found that the attainments of the textbook and the curriculum in the units "Force and Energy", "Pure Matter and Mixtures", "The Interaction of Light with Matter", and "Electric Circuits" were in agreement. However, in the unit of "Cell and Divisions", the relationship between the textbook and the attainments was indirect. It is undeniable that the curriculum, teacher qualifications, and student-teacher communication are as effective as textbooks to effectively perform science education (Atici, Keskin Samancı & Ozel, 2007). Textbooks written in line with the curricula are supportive elements of the education process (Bostan Sarioglan, Can & Gedik, 2016). In this context, the coordination between the science curriculum of the "Cell and Divisions" unit and the textbook could not be achieved. The differences between the science textbook and the curriculum make it compulsory for teachers to benefit from both sources when creating the teaching environment.

In the engineering assessment criterion, the six project design sections in the textbook are considered a skill area in which the students are aware of the steps of conducting research, finding solutions, and have recognition acquired as a result of their experiences. In the learning environment, students undertake the role of an individual who researches, questions, explains, and transforms information into products (MoNE, 2018). With the project design sections, students are provided with a suitable environment to fulfil these roles. It was found that the project design parts in the units "Force and Energy", "Pure Substances and Mixtures", "The Interaction of Light with Matter", and "Electrical Circuits" enable students to develop a suitable model for the solution. In contrast, in the unit "Cell and Partitions", students may experience some difficulties. According to Kizilay (2018), the reflection of developments and changes in our education system in our age requires that pre-service science teachers, who will be the guides of the science course, have sufficient knowledge about engineering, entrepreneurship, and design. Therefore, teachers and pre-service teachers who are well-equipped in engineering, entrepreneurship, and design can provide effective science education and solve the difficulties encountered.

In the entrepreneurship assessment criterion, it is stated in the project design parts in the units of "Cell and Divisions", "Force and Energy", "Pure Substances and Mixtures", "The Interaction of Light with Matter", and "Electric Circuits" that model presentation will provide students with 21<sup>st</sup>-century and entrepreneurial skills. Individuals of our age

should have 21<sup>st</sup>-century skills such as researching, questioning, critical thinking, collaboration with others, and problem-solving (Eryilmaz & Uluyol, 2015). It can be reported that the project design parts contribute to the training of individuals who are fit for 21<sup>st</sup>-century requirements. Students acquire scientific process skills, life skills, engineering and design skills and transform these skills into applications in entrepreneurship and technology with the attainments in the science curriculum (Eke, 2018). This way, coordination between the curriculum and the textbook is ensured. Although different marketing alternatives are presented to the students to introduce the products they designed at the end of year science festival, marketing strategies are not included in the project applications. For students to acquire marketing strategies, the product should be evaluated first. It is not possible to make progress on this only with the instructions in books. According to MoNE (2018), students acquire entrepreneurship skills while creating strategies and using promotional tools to market their products. Therefore, it is aimed that the students acquire entrepreneurship skills by experiencing them.

In the SEE assessment criteria, it is stated in the project design sections in the units "Cell and Divisions", "Force and Energy", "Pure Substances and Mixtures", "The Interaction of Light with Matter", and "Electric Circuits" that students can acquire scientific knowledge as a result of their experiences by using the scientific process skills and design steps. Additionally, the successive presentation of the scientific process skills and EDP in the textbook concludes that it helps students establish a relationship between the two. Individuals use scientific process skills throughout their education and training processes, especially in science, physics, chemistry, and engineering (Yildirim & Altun, 2015). EDP is effective in developing students' scientific process skills. Therefore, it can be claimed that scientific process skills and engineering design processes constitute the infrastructure of the project design.

Although a description based on material, time, and cost criteria is included in some project design sections, it was not included in other sections. Making the necessary explanations in the EDP content of the textbook is a complement to the project design sections. Similarly, it is included in the relevant description sections that students are not expected to create a product by combining scientific knowledge with engineering applications and turning their designs into a three-dimensional model. Creating a three-dimensional model depends on the conditions. However, in the EDP content of the textbook, some instructions are complementary to these explanations. Teachers must make a lesson plan that integrates the curriculum with the textbook to prepare an effective science learning environment.

Different expressions in the project design sections state that there will be an end-of-year science festival where the products designed by students will be exhibited and presented at the end of the semester.

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## Appendices

### Appendix 1. Project in Unit 2: "The Cell and Divisions"

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**Projeni Tasarla**




"Hücre Bölünmeleri" ünitesinde öğrendiğiniz konularla ilgili günlük hayatta karşılaşılan bir problem veya ihtiyaç belirleyiniz. Belirlediğiniz problemi çözmeye veya ihtiyacı karşılamaya yönelik bir araştırma projesi hazırlayınız.

basamakları örnek olarak hazırladığınız tasarımınızı okulda yapılacak olan "**Yıl Sonu Bilim Şenliği**" nde sunmak için sene sonuna kadar muhafaza ediniz. Ürününüzün sunumu için etkileyici bir tanıtım (gazete, internet, televizyon reklamı hazırlamak gibi) hazırlayınız.

### Appendix 2. Project in Unit 3: "Force and Energy"

**Projeni Tasarla**




Arkalarında kasaları bulunan kamyonları yollarda görmüşsünüzdür. Bu kamyonların kabinlerinin üzerinde yer alan ve açılı şekilde duran parçaların ne işe yaradığını hiç düşündünüz mü? Kamyon kasaları, daha fazla yük taşımak için genellikle kamyon kabininden daha yüksek yapılıdır. Bu durum kasanın hava direncinden daha fazla etkilenmesine ve kamyonun hareketinin zorlaşmasına neden olur. Kamyon kabinlerinin üzerine eklenen eğimli bir parça, kamyon hareket ederken kasaya gelen rüzgârın yönünü değiştirir. Bu basit çözüm sayesinde kamyonun etki eden hava direnci azaltılmış olur. Dolayısıyla yakıt tüketimi de düşer.

Bazı canlılar yaşadıkları ortamlardaki hava ve su direncini azaltan doğal özelliklere sahiptir. Hava ve su direncini azaltmak için doğadaki canlılardan esinlenmek sık kullanılan bir yöntemdir. Örneğin bir denizaltı tasarımı için balıklar, bir hızlı tren tasarımı için kuşlar örnek alınmıştır. Bu sayede bazı canlıların sahip oldukları doğal özellikleri teknolojik tasarımlara aktarılmış olur.

Siz de mühendislerin hava ve su direncini azaltmaya yönelik tasarladığı bu araçlara benzer kendinize ait bir araç tasarlayınız. Tasarımınızı, öğretmen rehberliğinde ve sınıf ortamında; sayfa 14, 15, 16 ve 17'deki proje örneğini, bilimsel süreç ve tasarım basamaklarını kullanarak hazırlayınız. Hazırladığınız tasarımınızı okulda yapılacak olan "**Yıl Sonu Bilim Şenliği**"nde sunmak için sene sonuna kadar muhafaza ediniz. Ürününüzün sunumu için etkileyici bir tanıtım (gazete, internet, televizyon reklamı vb.) hazırlayınız.




### Appendix 3. 1<sup>st</sup> Project in Unit 4: "Pure Substances and Mixtures"

**Projeni Tasarla**




1 litre atık yağ 1 milyon litre suyu kirletebilmektedir. Kanalizasyon hatlarının tıkanmasına neden olan, arıtma tesislerinin işletme maliyetini arttıran, çevre ve insan sağlığına zarar veren atık bitkisel yağların toplanması ve bu yağların geri dönüşümünü sağlamak amacıyla çalışmalar yapılmaktadır. Çevre ve Şehircilik Bakanlığı tarafından da desteklenen "Sıfır Atık Projesi" kapsamında atık bitkisel yağların toplanması ve geri dönüşümü için uğraş veren bir ilçe belediyesi şehrin farklı yerlerine bitkisel atık yağ toplama makineleri koyarak bu işlemi kolaylaştırmıştır. Daha önce çevre zabıtası tarafından evlere gidilerek araçla toplanan atık yağlar artık bu makinelerde toplanmaktadır. Makineler, yağı dökmeden önce yapılacak işlemler hakkında sesli uyarı sistemiyle vatandaşlara bilgi vermektedir. Vatandaşlar bu noktalara gelip atık yağlarını makinenin üzerinde bulunan bölmeden dökerek, döktükleri yağ miktarına göre puan kazanmaktadır. Makineden toplanan puanlarla çeşitli hediyeler alınabilmektedir.



Siz de yapılan bu projeye benzer "Evsel katı veya sıvı atıkların geri dönüşümüne yönelik bir proje" geliştirin. Proje, öğretmen rehberliğinde ve sınıf ortamında; sayfa 14, 15, 16 ve 17'de verilen proje örneğini, bilimsel süreç ve tasarım basamaklarını kullanarak geliştiriniz. Bu basamakları örnek alarak geliştirdiğiniz projenizi okulda yapılacak olan "**Yıl Sonu Bilim Şenliği**"nde sunmak için sene sonuna kadar muhafaza ediniz. Projenizin sunumu için etkileyici bir tanıtım (gazete, internet, televizyon reklamı vb.) hazırlayınız.

#### Appendix 4. 2<sup>nd</sup> Project in Unit 4: "Pure Substances and Mixtures"

**Projeni Tasarla**




Antalya - Konyaaltı Belediyesi, kullanılmış kıyafetlerin çöpe atılmasını önleyerek geri dönüşürülmesini sağlayacak bir projeyi hayata geçirdi. Konyaaltı Belediyesinin yaptığı "**Giymiyorosan Giydir Projesi**"nin amacı, kullanılmayan kıyafetleri ihtiyaç sahiplerine hızlı ve kolayca ulaştırmaktır. Bununla birlikte kullanılmayacak durumda olan kıyafet ve ayakkabıları da geri dönüşüme göndererek ekonomiye kazandırmaktır. Bu kapsamda 200 ayrı noktaya "Kullanılmış Giysi ve Ayakkabı Kumbaraları" yerleştirildi. Konyaaltı Belediyesi yetkilileri: "Vatandaşlarımız, artık dolapta beklettikleri giysi, ayakkabı, çantalarını veya her türlü tekstil ürününü bu kumbaralara bırakabilecekler. Toplanan giysiler, ayrıştırılıp temizlendikten sonra bir kısmı Kültür ve Sosyal İşler Müdürlüğümüz vasıtasıyla Konyaaltı'nda yaşayan ihtiyaç sahibi vatandaşlarımıza ulaştırılacak, diğer kısmı ise geri dönüşüme gönderilerek ekonomiye kazandırılacak. Gelen taleplere göre kumbaraların sayısı da arttırılacak. Bu kampanya ile vatandaşlarımız kullanmadıkları eşyalarını da değerlendirmiş olacak." dedi.



Siz de Konyaaltı Belediyesinin yapmış olduğu projeye benzer kendinize ait "Yeniden kullanılabilir eşyaların, ihtiyacı olanlara iletilmesine yönelik" bir proje geliştiriniz.

Projenizi, öğretmen rehberliğinde ve sınıf ortamında; sayfa 14, 15, 16 ve 17'de verilen proje örneğini, bilimsel süreç ve tasarım basamaklarını kullanarak geliştiriniz. Bu basamakları örnek alarak geliştirdiğiniz projenizi okulda yapılacak olan "**Yıl Sonu Bilim Şenliği**"nde sunmak için sene sonuna kadar muhafaza ediniz. Projenizin sunumu için etkileyici bir tanıtım (gazete, internet, televizyon reklamı vb.) hazırlayınız.

#### Appendix 5. Project in Unit 5: "The Interaction of Light with Matter"



### Projeni Tasarla



**Anton van Leeuwenhoek** (Anton van Lövenhuk), bir sepetçinin oğlu olarak dünyaya geldi. 16 yaşındayken bir kumaş tüccarının yanında çıraklık yaptı. Basit büyüteçlerle ilk defa o yıllarda ilgilenmeye başladı. Kendi kumaş işini kurduktan sonra da merceklerle ilgilenmeye devam etti. Cam işine aşina olması, merceklerle uğraşmasını



kolaylaştırıyordu. O zamana kadar yapılan mikroskoplar 20 veya 30 kat büyütme oranına sahipti. Ancak bu büyütme oranları araştırmalar için yeterli değildi. Ayrıca bunları üretmenin teknik zorlukları vardı. Anton van Leeuwenhoek basit gözlemler yapmak için, kendi mikroskopunu üretmenin yollarını araştırdı. Robert Hooke'un mikroskop ile yaptığı gözlemlerini anlatan kitabının bir kopyasını aldı. Bu kitap, mikroskoplarla ilgili araştırmalarını kolaylaştırdı. Daha sonra Van Leeuwenhoek, kendi mikroskopunu geliştirmeye başladı. Mercek konusundaki bilgisi ve çalışma azmi sayesinde 200 katın üzerinde büyütme oranı elde etmeyi başardı.

Van Leeuwenhoek'in tasarımı, metal bir levha üzerindeki küçük bir deliğe monte edilen tek bir mercekten oluşuyordu. Konumu ve odak noktası iki vidanın döndürülmesi ile ayarlanıyordu. Sadece 8-10 cm uzunluğundaki mikroskop göze yakın tutulmalıydı, bu da çok iyi bir ışıklandırma ve sabir gerektiriyordu. Anton van Leeuwenhoek, kendi tasarımı olan el yapımı mikroskoplar kullanarak mikroskopik canlıları gözlemleyen ve tanımlayan ilk kişi oldu.

Van Leeuwenhoek mercekler kullanarak bir görüntüleme aracı tasarlamıştır. Siz de mercek (ince kenarlı, kalın kenarlı), ayna (düz, çukur, tümsek) ya da başka malzemeler kullanarak kendi ihtiyaçlarınıza yönelik bir "görüntüleme aracı" tasarlayınız. Bir problemi çözmeye ya da varolan bir aracı geliştirmeye yönelik tasarımınızı öncelikle çizimle ifade etmeniz gerekmektedir. Projeyi, öğretmen rehberliğinde ve sınıf ortamında; sayfa 14, 15, 16 ve 17'de verilen proje örneğini, bilimsel süreç ve tasarım basamaklarını kullanarak geliştiriniz. Geliştirdiğiniz projenizi okulda yapılacak olan "Yıl Sonu Bilim Şenliği"nde sunmak için sene sonuna kadar muhafaza ediniz. Projenizin sunumu için etkileyici bir tanıtım (gazete, internet, televizyon reklamı vb.) hazırlayınız.

## Appendix 6. Project in Unit 7: "Electric Circuits"



### Projeni Tasarla



Şehirlerde aydınlatma uzun yıllar boyunca mum ve gaz lambaları ile yapılmıştı. **Edison** bu durumu değiştirmek için arkadaşlarıyla kendi araştırma laboratuvarında işe koyuldu. Defalarca yapılan denemelerde kömürleştirme işleminden geçmiş mukavva, Hindistan cevizi kabuğu, mantar gibi pek çok farklı madde kullanılmasına rağmen Edison aradığı ucuz ve dayanıklı ampulü yapmayı başaramadı.



1879 yılının Kasım ayında neleri değiştirebileceğini düşünürken ceketinin bir düğmesinin kopuk olduğunu ve oradan bir iplik parçasının sarktığını gördü. Birden yerinden fırlayıp laboratuvarına giderek çalışanlarından bir yumak ipliği küçük parçalara ayırıp kömürleştirmelerini istedi. Yaptıkları bu son denemede havası boşaltılmış ampulün içindeki iplik, elektrik verildiğinde kızardı ve etrafa sarı bir ışık yaydı. Ampul saatlerce sönmedi ve Edison amacına ulaşmış oldu. 4 Eylül 1882 tarihinde şehre elektrik akımı verildi. Edison'un icat ettiği ampuller mahalledeki yüzlerce evi aydınlattı.

Siz de Edison'un ampulü icat ederken yaptığı araştırma ve tasarım sürecine benzer günlük hayattan bir ihtiyacınıza yönelik "özgün bir aydınlatma aracı" projesi tasarlayınız. Bir problemi çözmeye ya da var olan bir aracı geliştirmeye yönelik tasarımınızı öncelikle çizimle ifade ediniz. Daha sonra araç-gereçleri temin ederek çiziminizi üç boyutlu modele dönüştürünüz.

Projeyi, öğretmen rehberliğinde ve sınıf ortamında; sayfa 14, 15, 16 ve 17'de verilen proje örneğini, bilimsel süreç ve tasarım basamaklarını kullanarak geliştiriniz. Geliştirdiğiniz projenizi okulda yapılacak olan "Yıl Sonu Bilim Şenliği"nde sunmak için sene sonuna kadar muhafaza ediniz. Projenizin sunumu için etkileyici bir tanıtım (gazete, internet, televizyon reklamı vb.) hazırlayınız.