A NEEDS ANALYSIS TO DEVELOP AN ASTRONOMY PROGRAM FOR TURKISH ELEMENTARY AND SECONDARY SCHOOLS

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OKTAY KAHRAMAN

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Prof. Dr. Canan Özgen
Director

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

Prof. Dr. Ömer Geban
Head of Department

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

Assist. Prof. Dr. Ali Eryılmaz
Supervisor

Examining Committee Members

Assoc. Prof. Dr. Ercan Kiraz	(METU, EDS)	_____
Assist. Prof. Dr. Ali Eryılmaz	(METU, SSME)	_____
Assoc. Prof. Dr. Behiye Ubuz	(METU, SSME)	_____
Assist. Prof. Dr. Sinan Kaan Yerli	(METU, PHYS)	_____
Dr. Mehmet Sancar	(METU, SSME)	_____

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Name, Last name : Oktay Kahraman

Signature :

ABSTRACT

A NEEDS ANALYSIS TO DEVELOP AN ASTRONOMY PROGRAM FOR TURKISH ELEMENTARY AND SECONDARY SCHOOLS

Kahraman, Oktay

MS, Department of Secondary Science and Mathematics Education

Supervisor: Assist. Prof. Dr. Ali Eryılmaz

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In this study, needs analysis has been made to gather the necessary data for developing a possible astronomy program for elementary and secondary schools in Turkey. In order to collect and to determine the students' and teachers' needs, 35 elementary schools and 20 secondary schools in the six districts (Keçiören, Çankaya, Yenimahalle, Altındağ, Mamak and Sincan) of Ankara in Turkey has been visited during 2004-2005 fall semester. 2133 elementary and 1180 secondary school students, and 37 teachers were involved in the study.

In the first part of this study, the international science curricula were examined and the studies related with the concepts of astronomy and astronomy education was analyzed. According to the gathered data from the literature, it was observed that in the international science curricula astronomy education has an important part and most developed countries have astronomy standards in their elementary and secondary school. However, the importance of Turkish National Education given on Astronomy education was not as high as it was supposed to be compared to the international science programs. Also, it was viewed that there is no Astronomy education during secondary school education; there are no standards for Astronomy education in the national science education policy.

In the second part of this study, the elementary and secondary school students' and teachers' opinions were collected. The opinions of the students and the teachers have been collected via questionnaires. These questionnaires have been designed to find answers to six sub-categories of the main problem. The sub-categories can be listed as the content of the program that was aimed to be developed, teaching and learning methods, evaluation period, educational atmosphere and facilities, significance of the astronomy course, and lastly the relationship between the students' demographic features and preference of astronomy education.

According to the gathered data from the questionnaires, the teachers supported the idea that a possible Astronomy course should be included in the curriculum of elementary education starting with the 6^{th} grade, and they had a common opinion that an astronomy course should take part also in secondary school education. Moreover, most of the students who attended this study want to have a separate astronomy course in their education. Also, the findings revealed that there is a parallelism between the astronomy programs defined in the international arena and the teachers' and students opinions about the content of the astronomy course in this study.

To conclude, it was observed that the astronomy subjects listed in the questionnaire was selected with high percentages. Besides, for teaching and learning method the participants in the study wanted experiments and projects that are clear, comprehensible and related to daily life experiences. Also, performance based evaluation was supported in the evaluation process. Moreover, an education environment where there are visual based materials and teacher – student cooperation is expected when teaching astronomy subjects. Lastly, according to teachers and students, the most important benefit of teaching and learning astronomy is getting information and recognizing the facts about the Earth and the Universe.

Keywords: needs analysis, curriculum development, astronomy curriculum, astronomy education

ÖZ

TÜRKİYE'DE İLKÖĞRETİM VE ORTAÖĞRETİM OKULLARINA ASTRONOMİ PROGRAMI GELİŞTİRİLMESİ İÇİN İHTİYAÇ ANALİZİ

Kahraman, Oktay
Y. Lisans, Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümü
Tez Yöneticisi: Yrd. Doç. Dr. Ali Eryılmaz

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Bu çalışmada, Türkiye'de ilköğretim ve ortaöğretim okullarında geliştirilebilecek Astronomi programı için gerekli verilerin elde edilmesi için bir ihtiyaç analizi yapılmıştır. İhtiyaç analizinin öğrenci ve öğretmen boyutunun araştırılması için Türkiye'nin Ankara ili sınırları içerisinde merkeze bağlı Keçiören, Çankaya, Yenimahalle, Altındağ, Mamak ve Sincan ilçelerindeki Milli Eğitim Bakanlığına bağlı 35 ilköğretim ve 20 ortaöğretim okulunda 2004 – 2005 güz döneminde anket uygulanmasına gidilmiştir. 2133 ilköğretim ve 1180 10. sınıf ortaöğretim öğrencisine ve 37 ilköğretim ve ortaöğretim öğretmenine ulaşılmıştır.

Bu çalışmanın ilk aşaması, uluslararası fen programlarının taranmasını ve Astronomi ve Astronomi eğitimi ile ilgili yapılmış olan araştırmaların değerlendirmesini içermektedir. Tarama sonucu elde edilen bulgulara göre, uluslararası fen programlarında astronomi eğitimine büyük önem verildiği ve pek çok gelişmiş ülkede ilköğretim ve ortaöğretim düzeyinde astronomi standartları olduğu bulgusuna rastlanmıştır. Ancak, uluslararası fen programları ile kıyaslandığında ülkemizin Astronomi eğitimine verdiği önemin istenilen düzeyde olmadığı görülmüştür. Özellikle ortaöğretimde astronomi eğitimine yer verilmediği ve astronomi eğitimi ile ilgili ulusal fen eğitimi içinde astronomi standartlarının oluşturulmadığı görülmüştür.

Çalışmanın ikinci aşaması, öğrenci, öğretmen ve uzman görüşlerinin alınmasıdır. Öğrenci ve öğretmen görüşlerine ulaşmak için anket çalışması yapılmıştır. Anketler altı alt kategorisine cevap bulmak için hazırlanmıştır. Bu alt kategorik problemler; astronomi ile ilgili hazırlanacak bir programın içeriği, eğitim ve öğretim yöntemi, değerlendirme, eğitim ortamı ve olanakları, astronominin önemi ve son olarak öğrencilerin demografik özelliklerinin astronomi tercihleriyle olan ilişkisi olarak sıralanabilir.

Anket çalışması ile ulaşılan uzmanların ve öğretmenlerin böyle bir astronomi dersinin ilköğretim 6. sınıftan itibaren ilköğretim müfredatında olması gerektiği düşüncesine olumlu baktığı ve böyle bir astronomi dersinin ortaöğretim müfredatında da olması gerektiği fikrine sahip oldukları görülmüştür. Benzer şekilde, anket çalışması ile ulaşılan ilköğretim ve ortaöğretim öğrencilerinin astronominin bir ders olarak okutulmasını istedikleri görülmüştür. Öğretmenlerin ve öğrencilerin, uluslararası düzeyde belirlemiş olan astronomi programlarının sahip olduğu içeriğe benzer talepleri olduğu bulgusuna ulaşılmıştır.

Son olarak, öğretmen ve öğrenci görüşlerinden elde edilen verilere göre astronomi ile ilgili anketlerde verilen konuların yüksek yüzdelerle istendiği görülmüştür. Eğitim ve öğretim metodu olarak açık, anlaşılır ve gündelik yaşamla ilişkili deney ve projelerin olmasını istedikleri ortaya çıkmıştır. Performansa bağlı değerlendirmenin tercih edildiği bulgusuna ulaşılmıştır. Eğitim ortamının görsel malzemelerle desteklenmesini ve eğitim sürecinde öğrenci öğretmen işbirliğinin sağlanmasını bekledikleri görülmüştür. Böyle bir dersin dünyayı ve evreni daha iyi tanımalarına yardımcı olacağına inandıkları bilgisine ulaşılmıştır.

Anahtar kelimeler: ihtiyaç analizi, astronomi programı, astronomi eğitimi, program geliştirme

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LIST OF ABBREVIATIONS

AAAS: American Association for the Advancement of Science

AHS: Anatolian High Schools

NRC: National Research Council

NSES: National Science Education Standards

Q-DESO: A Questionnaire to Determine the Elementary Students' Opinions about the Development of the Astronomy Program

Q-DSSO: A Questionnaire to Determine the Secondary School Students' Opinions about the Development of the Astronomy Program

Q-DTO: A Questionnaire to Determine the Teachers' Opinions about the Development of the Astronomy Program

RSS: Regular Secondary Schools

SCC: Subject Centered Curriculum

SSPC: Secondary Schools with One Year English Preparation Class

CHAPTER 1

INTRODUCTION

Astronomy is a crucial discipline to the basic science. Tunca (2002) emphasizes that astronomy is the application area to the basic sciences. It provides accurate and reasonable thinking and allows individuals to use the scientific facts effectively. Percy (1998) also emphasizes that astronomy education is important to create the future astronomers and astronomy educators. It is important because it is deeply rooted in every culture; it has application to everyday life; it progresses physics and other sciences; it is a dynamic and relevant science; it concerns the origin of the cosmic and our place in time and space; besides, it increases the curiosity, imagination, and sense of the exploration and discovery. He also asserts that astronomy increases the individual and society awareness for the science and technology, and it attracts young people to study this field, and lastly it is very important for the developing countries in order to improve the technological capacity.

McNally (1982) emphasizes that there are two opposite ideas concerning whether or not astronomy should be taught at schools in United Kingdom. The first block claims that astronomy should not be taught in schools since the school is not well equipped to teach astronomy and there is a lack of adequate and qualified teaching of astronomy at schools. However, the second block asserts that astronomy should be taught in schools at all levels and the earlier will be the better.

Astronomy is related with many disciplines such as chemistry, geology, mathematics, meteorology, and physics. Major subjects come from mathematics and physics (McNally, 1982; Tunca, 2002). McNally (1982) emphasizes that astronomy should be placed in the teaching of physical sciences and mathematics. He also asserts that schools should teach the astronomy to provide a perspective of the importance of the space, the nature

of the universe, and to demonstrate its practical role to play in everyday affairs and the means for navigation and surveying. “Astronomy provides a superb medium trough which the atomic world can be manifest on a large scale” (McNally, 1982, p. 158).

Wentzel (1990) defines two different education systems to the astronomy education. These are the classical or European and the American systems. European system supports that the astronomy should be taught in secondary schools and universities, but in the American system, astronomy is taught to non-science students in universities as a part of “science requirement”. Wentzel (1990) also emphasizes that series of an astronomy topics are taught as a part of the curriculum in elementary schools in both systems. Percy (1998) emphasizes that there is discussion about whether astronomy should be taught as a separate subject or as part of other subjects, and what are the topics that are to be taught. Another important discussion is about what should be the level that astronomy can be taught and how it should be taught. He claims that majority of the elementary school teachers’ lack of knowledge about science, or science education, especially, about astronomy. He adds that there is no accurate and simple coordination between the concepts and students’ intellectual development, and poor techniques are limited to lectures and textbooks. Moreover, he states that astronomy is less often taught in secondary school, and teachers at that level are generally better educated when compared with the elementary school teachers in science.

There is no any study about whether astronomy should be taught as a separate subject or as a part of other subject, what are the topics are to be taught and what should be the level that astronomy can be taught in Turkey. The opinion of the teachers and the students becomes more important to find the answers of the questions that mentioned above. The needs analysis is the one of the efficient way of collecting the opinions of the teachers and students to find the answers of those questions.

1.1 The Purpose of the Study

The purpose of this study is to make needs analysis in order to develop an astronomy program for elementary and secondary schools in Turkey. In the light of this purpose, the first dimension of the study is to investigate the astronomy programs used in various countries so as to see the whole picture of the national curriculum framework of the various countries about the astronomy education standards and to compare the different nations' curriculum frameworks of astronomy standards with the astronomy part of the national science curriculum of Turkey. By analyzing astronomy programs of different countries, the Astronomy subjects that are not included in our national science curriculum can be defined. Also, the age and grade levels that astronomy subjects are taught in international curricula can be analyzed, so the appropriate age and grade levels for the astronomy subject taught in our schools can be determined. In addition, the astronomy subjects that are taught in international science curricula, but not taught in our national curriculum, can be presented to the teachers and students and their opinions about these new subjects can be gathered.

The second dimension of the study is to survey teachers, elementary and secondary schools students' opinion about the content, the teaching and learning methods, the evaluation process, the learning environment and facilities, and the significance of the astronomy course in order to develop an astronomy program for Turkish elementary and secondary schools.

The third dimension of this study includes the relationship between the demographic features of the students and their astronomy preference. These demographic relations with astronomy education can be a guide the program developers when developing an astronomy program, and they can keep these relations in mind while selecting the astronomy subjects.

1.2. The Main Problem and Subproblems

This study has tree main problems and each problem has one or more subproblems.

1.2.1. The First Main Problem and its Subproblem

What are the general characteristics of international astronomy programs and what are the similarities and differences between these programs and the astronomy subjects in our national science program?

1.2.1.1. Sub Problem

a) Subproblems about examining the various nations' curricula in terms of astronomy education

- What kinds of study do the researchers make about the astronomy education?
- What are the astronomy curricula used in various countries?
- What is the astronomy program included in the national science curriculum of Turkey?
- What is the difference between the national science curriculum of Turkey and other various countries with respect to astronomy program?

1.2.2. The Second Main Problem and its Subproblems

What are the opinions of the elementary and secondary schools' students and teachers about the content, the teaching and learning methods, the evaluation process, the learning environment and facilities, and the significance of the astronomy course in order to develop an astronomy program for Turkish elementary and secondary schools in the context of the needs analysis?

1.2.2.1 Sub Problems

Five categories were formed under the main problem. These categories can be listed by: the opinions of the students and teachers about the content of the astronomy course, the teaching and learning methods in the astronomy course, evaluation process in the astronomy course, the learning environment and facilities in the astronomy course, and finally the significance of the astronomy course. The following subproblems were developed in those seven categories:

a) Subproblems about the opinions of the students and teachers about the content of the astronomy program

- What kind of topics do students want to learn in the astronomy program in elementary and secondary schools?
- To which levels and to which student groups can the astronomy topics be appropriate according to the teachers?

b) Subproblems about the opinions of the students and teachers about the teaching and learning methods in the astronomy learning/teaching

- What kind of teaching and learning methods (necessity to learn the astronomy subjects better) do students prefer when learning the astronomy?
- What kind of teaching and learning methods (necessity to learn the astronomy subjects better) do the teachers prefer when teaching the astronomy?

c) Subproblems about the opinions of the students and teachers about the evaluation process in the astronomy learning/teaching

- What kind of evaluation process do students and teachers prefer in the astronomy learning/teaching?

d) Subproblems about the opinions of the students and teachers about the learning environment and facilities in the astronomy learning/teaching

- What kind of teaching – learning environment do students prefer when studying astronomy?

e) Subproblems about the opinions of the students and teachers about the significance of the astronomy learning/teaching

- What are the students' opinions about the effects of the astronomy subjects in terms of scientific knowledge, attitude, value, cognitive process and abilities in both their and other people's lives?
- What are the students' opinions about the effects of the astronomy on science and technology?

1.2.3. The Third Main Problem and its Subproblem

What are the relationships between the demographic features of elementary and secondary schools students and their preference of astronomy?

1.2.3.1. Sub Problem

a) Subproblems about the correlation between demographic characteristic of the students and their preference of the content of the astronomy

- What is the relationship between gender and preference of astronomy?

- What is the relationship between grade levels in elementary schools and preference of astronomy education?
- What is the relationship between secondary school types and astronomy preference?
- What is the relationship between students and parents' education level and astronomy preference?

1.3. Significance of the Study

Most of the countries in the world give emphasis to astronomy education. Varied studies are being made in order to develop and improve this education more effective. "Astronomy education and teaching goes back in 1933 in Turkey" (Tunca, 2002, p.1). Tunca (2002) emphasizes that astronomy topics was instructed as a must course until 1974, and after that year, it was instructed as an elective course, but except a few examples, it was not placed as a course in the curriculum.

Although there is still an elective astronomy course in the curriculum of secondary schools, it is not selected by the students due to the inactivation of it. Lack of textbooks and instructors, and its importance in the University Entrance Exam (UEE) could be another reason. The general approach of the decision makers is putting the astronomy topics in science courses such as science and social courses, and geography instead of opening as a must and independent course, especially in the secondary school curriculum (Tunca, 2002, p.1).

In Turkish education system, it can be easily observed that these studies are quite limited and insufficient. The specific astronomy standards in the given topics are unformed because of the insufficient studies about the astronomy education. The form and content of astronomy topics given under Science courses in elementary schools are limited. Moreover, there is no place of the astronomy subjects in secondary school curriculum support the sentence above.

For this reason, the fact that limited education of astronomy in elementary schools and lack of the curriculum covering astronomy subjects in secondary schools shows the necessity of this study. The results of the study will be helpful for the understanding of the various countries curricula and varied studies related with the astronomy, and also it will be helpful for revealing the opinions of the teachers' and students' opinions about the astronomy learning/teaching.

CHAPTER 2

LITERATURE REVIEW

2.1. Curriculum and Curriculum Development

In order to develop appropriate curriculum for astronomy; first of all, the definition and components of the curriculum should be considered carefully. There are lots of definitions of the curriculum. Saylor and Alexander (1964) emphasize that curriculum involves school experiences and its ends that learners may accomplish with the help of instructions. Doğan (1975) asserts that curriculum is said to be the total planned activities, and its basic aim is to get expected learning outcomes from learners. Ertürk (1982) describes that curriculum is the order of valid learning experiences. Besides, Oliva (1992) defines curriculum as the list of topics, contents of the course, planning of the studies, the list of instruction materials, the arrangement of courses, the total of behavioral objectives, everything that is taught in-schools and out-of-schools, and everything that is planned by the school administrator. Elliott (1991) believes that curriculum involves clarifications of procedural aims and principles for the teaching and learning of particular kinds of content. On the other hand, Varış (1994) emphases that curriculum involves all activities that allow realizing national and institutional goals. Also, Bishop (1995) states that the general definition of the curriculum can be taught as a total of experiences that learners undergo. A curriculum is a dynamic set of forces: the actual form that curricula take in particular settings represents the balance of the interplay of separate interest (Barnett, Parry, & Coate, 2001, p.438). Demirel (2004) defines curriculum as the order of learning experiences provided for learners inside and outside of the school. In short, curriculum can be considered as a school program that includes both inside and outside of schools' efforts to impress learning for the learners.

Curriculum is different from instruction or syllabus. Dick and Carey (1996) suggest that the former is the systematic process, and every component (instructors, materials, and learners) is crucial to successful learning; however, instruction is a part of the total curriculum. A curriculum is also much wider than a syllabus.

A syllabus is only part of the total curriculum. A curriculum is concerned not so much with one describing the knowledge to be acquired as with the area of learning experiences to be organized by the teachers, both within and outside the school, to enable pupils to adopt a positive attitude to learning, to acquire and apply the knowledge and skills, and to develop their tastes and balanced sense of values (Bishop, 1995, p.1).

There are eight main factors that determine the curriculum. Bishop (1995) classifies these factors by the following way; society, culture, philosophical issues, political issues, language, knowledge, psychological issues, and financial priorities and constrains. These factors should be deeply identified and analyzed when the curriculum is being prepared for the nation.

The society and culture are the first and important components when the curriculum is constructed. The educational system should reflect the needs of the society and culture, and it should also include some criteria that have relevance to the society and culture. Ayas, Çepni and Akdeniz (1993) assert that investigation of the national needs and condition of it is important. Williams (1969) states that curriculum is a cultural selection, the accepted values and morals of the society, appropriate knowledge and attitudes identified to the educated people, and particular skills covering the needs of learners and the society.

Such a curriculum would bring the students into the disciplinary community to develop and to contribute to that community practices, inculcating a progressive cycle of engagement and critical reflection, at private and public, of problematising and trying out answer (Parker, 2003, p.539).

Another determinant of the curriculum is the knowledge factor. Phenix (1964) classifies knowledge into six parts. These are symbolics (language, math), emprics (physical, biological, and social science), aesthetics (music, art,

and literature), ethics (morals), synoptics-integrative subjects (history and religion) and, the philosophical principles for selection of the content. These principles can be listed as (1) the knowledge must be gathered from the disciplines, (2) keys representing the discipline or subject should be chosen in each discipline or subject, (3) the content is selected so as to exemplify the characteristic methods of discipline, and (4) the content should be kneaded by the imagination.

The knowledge component of the curriculum must be attentively arranged in order to get scope, sequence, and integration. Scope refers to both content and mental processes. It provides appropriate scientific habit of thinking and it also provides coherence of subject matter, mental power, skills, attitudes, and values. It has horizontal relationship between the main areas of the knowledge. Sequence refers to the ordering or arrangement of the content and mental powers into a sequence and it provides continuity of the learning. It also has vertical relationship between the main areas of the knowledge. The integration refers to the appropriate configuration between the scope and sequence, and it allows the balance or well-rooted organization of the knowledge areas. It allows to setting the relationship between various areas of the curriculum at the same time.

Bruner (1966) argues that the curriculum should be organized and arranged around fundamental concepts and relationships. He also claims that a clear understanding of the fundamentals makes the subject more comprehensible to the learner; organization of the knowledge considering with principles and ideas bring about the easily recalling of the details and facilitates of the memory; mastery of general principles is helpful to transfer learning both in the future and other contexts; and fundamentals decrease the gap between elementary and advance knowledge in a subject.

It is clear that the needs and interest of learners and their development should be considered as a psychological issue. Whitehead (1970) emphasizes that all children goes through three stages when completing their maturation: a stage of the “Romance” (make-believe), a stage of “Precision”, and a final stage of “Generalization”. Moreover, Piaget (1954) also determines the

development of the children into four stages. These stages are sensori-motor, pre-operational or pre-conceptual, concrete operational, and formal operational stages. “Each child, in his own way, at his own rate, in his own time, and in his individual style, passes trough these stages in the same (manner) order” (Bishop, 1995, p.70). Furthermore, children’s intelligence, their previous learning experiences and social and cultural habits give shape to their mental and physical development. The needs of the children generally begin from the concrete to abstract, and both logical and psychological ground of needs improve from the simpler to the more complex. For this reason, when the curriculum is planned, logic and psychological condition of the child should be considered carefully rather than the logic of the subject matter. A child learns easily when he/she is ready. When he/she completes the appropriate stage of the intellectual and psychological development, the learning becomes more meaningful and permanent for him/her.

Identification and analysis of the curriculum factors is not the end process for the curriculum development. After identification of the factors, another important part appears. This is called organization of the curriculum. In order to organize the curriculum, some basic curriculum questions should be answered clearly. Tyler (1949) identifies four fundamental questions related with the curriculum process. (1) What educational purpose should the school seek to attain? What are the objectives we hope to achieve? What qualities of mind, and what knowledge, skills, and values are to be acquired? (2) What educational experiences, subject matters, and activities are the best to achieve purposes? (3) How can these educational experiences be effectively organized so as to constitute a practical guide to action? (4) How can we determine whether these desirable purposes are being attained? These can be briefly summarized as what, why, to whom, in what manner (how), and where to teach.

Hamilton (1976) analyzes curriculum conceptualizations into tree main categories: (1) curriculum content; what is taught, (2) for whom and how is prepared; organization of the teaching/learning process, the structure and sequence of the learning, and organization of the materials, (3) curriculum

situation; where is applied. Also, the curricula should be coherent and progressive (Knight, 2001, p.370). Coherent means that curriculum content, organization, learning and teaching strategies, and assessment arrangements dovetail with one another; pervading learning encounters, constituting an intentional discourse about what matters and rules of the game, and progression means conceiving of the curriculum (Knight, 2001, p.372).

These determinations allow constructing appropriate curriculum model. In the light of these points, several curriculum models are produced and these models can be used according to the needs of the nation, real situations of the nation, and global approaches. The first and well-known curriculum model is simple-four stage curriculum model that is developed by Tyler. He (1949) listed five sources for deriving objectives; (1) the learners, (2) the needs of contemporary society, (3) subject matter, (4) philosophy (sets of values), (5) psychology (the way children learn), (6) financial resources, and (7) appropriateness and achievement of the goals. Extension of this model is called "Subject Centered Curriculum". Also, except for this model, there are several curriculum models. These are "The Broad-Field Curriculum", "The Core Curriculum", and "Spiral Curriculum". Each of them has a different philosophy and many advantages and disadvantages.

Subject Centered Curriculum (SCC) is the oldest design in the world, the aim of SCC is to learn subject and to accumulate the information. It involves traditional content and teaching style. There are both strengths and weaknesses of SCC curriculum:

Strengths:

- Tried and proven
- Tight organization
- Rigidly sequenced
- Keeping track with each lesson's end
- Avoiding accidental duplication and simple testing

- Easy design of tests and dominating use of textbook
- Easy to implement
- Efficient
- Covering lots of content in a short time
- Adaptability to cope with inquiries, case studies, simulations and games, mastery learning, and discussion methods

Weaknesses:

- Considering unique needs and interests
- Lack of contemporary events
- Poor motivator for students
- Based on recalling rather than attempting to understand
- Little use of necessary reinforcement

There are some objections for this model. One of them is that if students do not learn the way we teach them, then we must teach them the way they learn (Marshall, 1991, p.226).

The Broad-Field Curriculum concerns solving problem by broadening subjects such as history, geography, and civic into a curriculum category with topics such as language arts (reading, writing, literature, and speech), physical science (physics, chemistry), biological science (anatomy, botany, physiology, zoology, and biology), and the Earth science (geology, physical geography, oceanography, mineralogy, paleontology, meteorology, space science). However, there are some disadvantages in this model. It may not be effective since it ignores the broad content generalization and it requires good note taking. Under best conditions, only 52% of the major ideas are captured in students' notes (Maddox, & Hoole, 1975, p.26). Moreover, students concentrate on less important points of the instruction and instructors need to be educated well.

The Core Curriculum is based on the idea that some contents are indispensable for all students. Oliva (1992) lists six characteristics of core curricula. These characteristics are constituting a portion of curriculum, unifying or fusing subject matter, cutting across the disciplines, organizing into blocks of time, encouraging teachers to plan with students, and providing pupil guidance (Oliva, 1992, p.305). The core curriculum involves multi-dimension that makes the curriculum appealing to advocates for the variety of philosophies. The core curriculum has been best received at the junior and senior high levels, but it has never universally accepted even at these levels (Henson, 1995, p.158).

Another curriculum type is the spiral curriculum. Spiral curriculum takes connectionism one step further, recommends that the some topics be returned to the curriculum at a later date, sometimes a higher grade level. Having gained in maturity and in the accumulation of prerequisite knowledge, students will be able to develop understanding that was beyond their capacity when simpler elements of topic were introduced earlier (Henson, 1995, p.173). Bruner (1966) emphasize that spiral curriculum is appropriate to improve and deepen skills, concepts, attitudes, and values, and it makes them easy to reach. There are some disadvantages of the spiral curriculum. Henson (1995) emphasizes that students may take a causal attitude toward the topics if they know that they have multiple opportunities to learn a concept, also another disadvantage of the spiral curriculum is to have a single designated grade level for each concept.

When the curriculum is developed, some quantities should be considered. Henson (1995) identifies these quantities as scope, sequence, continuity, articulation, and balance. He defines the scope as a breath of the curriculum at any level or at any given time; its horizontal dimension, sequence, as the order of topics over time; its vertical dimension, continuity, as the “smoothness” or lack of “disruption” in the curriculum over time; the articulation as the smooth flow of the curriculum on both vertical and horizontal dimension; and the balance as the “well-rooted” education.

Moreover, when the curriculum is developed, the role of the teachers also becomes more crucial (Elliott, 1991; Joyce, Calhoun, & Hopkins, 1997; Leat, & Higgins, 2002; Squire, Makinster, Barnett, Luehman, & Barab, 2001; Stenhouse, 1975; Yiğit, 2002; Yüksel, 2003). Stenhouse (1975) considers that there can be no educational development without teacher development. There are a few studies about the attitudes, choices and active joining of the teachers to the curriculum development. Elliott (1991) asserts that development of the curriculum begins with the development of the teachers. Also, he emphasizes that, in order to play an active role in the curriculum development, teachers should have sufficient knowledge about the aims of the curriculum, methods of curriculum, and what kind of ends of the curriculum are desired. There is no curriculum development without teacher development (Leat & Higgins, 2002, p.72).

Yiğit (2002) draws the path of the following ways when the curriculum is developed. He identifies orders of the development of the curriculum into tree steps; (1) identification of goals and targets that include the general and special goals should be defined and explained in a more detailed way, (2) identification of the appropriate content that involves appropriate chose of criterion such as philosophy, appropriateness of psychological and social conditions, learners' attention, and the utility of the content should be considered, and (3) the selection of the teaching and learning strategies should also be taken into consideration.

2.2. The Role of Needs Analysis in Curriculum Development

There have been several uses of the term "needs" in educational literature and practice (Leonard, 1960, p.84). Needs have been used in the education as curricular aims as well as in selecting subject matter and learning experiences (Tanner&Tanner 1995, p.285). A need is the lack of something that would further be the welfare of the individual (Beck, Cook & Kearney, 1956, p.53). Furthermore, needs have been thought to be facts, behavior, or skills that the young people does not posses; it is relation to some inner demand

which the child makes upon the environment; and it is a psychological one, gained from a study of the behavior of youth in social situations (Leonard, 1960, pp.84-85).

Needs are given a higher priority in the grand scheme of curriculum development (Oliva, 2001, p. 202). Curriculum developers must give their attention to five sources for curriculum development: (1) the needs of students in general, (2) the needs of the society, (3) the needs of particular students, (4) the needs of particular society, and (5) the needs derived from the subject matter (Oliva, 2001, p. 200). Moreover, community, students, teachers, parents and administrators identify and place the order of priority related with programmatic needs (Oliva, 2001, p. 200; Ornstein & Hunkins, 1988, p. 119). For this reason, the needs that are perceived by the teachers, students, parents, administrators, and community bring about the necessity of needs analysis at the beginning of a curriculum development.

McNeil (1996) defines the needs analysis as the process by which educational needs and its priorities are determined. He further supports that needs analysis is the most commonly used tool so as to find out curriculum aims and learning outcomes. Therefore, needs analysis is believed to be a start for a curriculum development. Sowell (2001) asserts that curriculum developers in the first stage should decide on the priorities in the content. Oliva (2001) proposes that needs analysis in a society forms a path to the aims of the curriculum because the aim of the curriculum fulfills the needs of the society. Sowell (2001) also believes that collection and interpretation of information related with needs analysis has an important effect on curriculum development.

Tyler (1949) suggests that the construction of needs analysis should include (1) intended learners, (2) contemporary society and (3) subjects specialist. The term “intended learners” means the group of students for whom the curriculum is planned. Oliva (2001) claims that as the society changes, the learners’ educational needs change too. Similarly, this situation reflects to the process of curriculum planning. “Contemporary society” can be defined as all the stakeholders (learners, teachers, parents etc.) related with educational field. McNail (1996) enlarges this term including health, economics, politics,

religion, family conservation, teaching, literacy, carrier matters, technological education and peace, but the related data should be relevant to the curriculum being developed. The last term of Tyler is "subject specialists" which means the group of people who deal with the specific contents of the education. McNail (1996) asserts that subject specialists have a great deal of contribution to the education. Moreover, Oliva (2001) claims they are essential source of curriculum since they have the basic information about the content. These variables that are mentioned by Tyler and supported by Oliva and McNail are the basic fundamentals for needs analysis, which means they are also crucial elements of curriculum development.

There is no doubt that curriculum planners should seek opinions of the teachers and students about what is needed in the curriculum (Oliva, 2001, p. 224). A common technique for getting opinions of them is applying questionnaire or opinion survey (Oliva & Pawlas, 2001, p.330).

2.3. Review of Studies Related with Astronomy Education

The amount of the researches in astronomy education is limited, and most of the educational researches related with the astronomy are studied to investigate astronomy misconceptions concerning sky objects and their motions. Sadler (1992) studied about astronomy misconceptions in the 1980's. This research is known as the "Projects STAR" study. He reports that the majority of secondary school students could not correctly answer simple multiple questions about the predictable motion of the day and night sky. However, Rollins, Dentton and Janke (1983); Frayer, Schween-Ghatala and Klausmeier (1972) find that students could not answer questions about the concepts of the day and night. Schneps (1987) argues that only two of twenty-tree adults could explain why the Earth is hotter in the summer than in the winter. The most cited reason is the Earth's distance from the Sun. Atwood and Atwood (1996) also report that 38 of the 49 elementary-education majors could not sufficiently explain the cause of the seasons, and 42 of the 49 could not

explain, verbally, the causes of the seasons using models. Philips (1991) finds same inaccurate conceptions about the Earth and the sky. Reed (1972) and Chamlis (1990) find that students could understand more easily the sky if they work with celestial spheres or planetarium environments. Treagust and Smith (1989) report that students think that temperature affects the gravity. They also define that students believe that planets with slow or no rotation have little or no gravity as they are far from the Sun. Also, Osborne and Gilbert (1980) and Philips (1991) confirm these facts in their reports that students believe that gravity needs air to exist. Moreover, many researches demonstrate the fact that these misconceptions are similar in different cultures (Baxter, 1989; Mali, & Howe, 1979; Nausbaum, 1979; Sneider, & Pulos, 1983). Callison and Wright (1993) report that students who use physical models beside mental models progress more significantly than that of students who merely use mental models, but there is no significant correlation between their spatial ability and the development of models. Baxter (1989) finds that students often believe that the Moon phases are resulted from the Earth' shadow. Moreover, the same result is confirmed by Skamp (1994) and Dai (1991). Taylor, Barker and Jones (2003) argue that in order to development of the conceptions about the night and day, months, years, seasons, the Moon's phases, eclipses, and tides, the learners should understand the relationship between the Sun, the Earth, and the Moon.

There are many studies about students' conceptions of the solar system. Slater (1993) argues that some students think that there are hundreds of stars in the solar system; the Sun will be a black hole; a space shuttle goes to the Moon each week; and comets and meteors appear in the same sky. Also, Vosniadou (1992) reports that students think the Earth's Moon is more like a star than the Sun.

There is lack of educational research about students conceptions or believes about the origin and evolution of the Earth and Universe. Roettger (1998) reports that about 80% of the experts that she interviewed with believe that the universe starts with galaxies and clusters of galaxies and reduces down to the Solar system and the Earth. She also emphasizes that students have a

poor conception about the universe. Philips (1991) reports that adults believe that the universe contains merely planets in our solar system and it is static. Also, students think that the planets and the Sun are formed directly with the Big Bang. Lightman and Sadler (1993) also argue that only 25% of the secondary school students can sufficiently read a diagram following instruction.

Vosniadou and Brewer (1994) show that children have a limited number of mental models so as to describe and explain astronomical phenomena. Barnett (2003) repots that students could develop some mental models of the Earth-Moon and the Sun system.

2.4. Astronomy Programs of Various Countries

Most countries have the National Science Education Standards (NSES) according to their education system. Astronomy is thought as a part of these standards. For example, Britain (Department for Education and Employment, 1999), North America (National Research Council, 1996), Australia (Board of Studies, 1998), Canada, New Zealand (Ministry of Education of New Zealand, 1993) and most European countries have their standards, also they include frameworks to design curriculum for K-12 astronomy education. For example, Science in the New Zealand Curriculum (1993) includes “making sense of the planet Earth and beyond” (p.114), “making sense of the nature of science and its relationship to technology”, “understanding aspects of the nature of science” (p.14), accessing tree aspects of the nature of science; “that science is a process which has been constructed by people” (p.9); “that science is influenced by the social and cultural framework in which scientist work” (p.24); and, “that science understanding changes over time” (p.24). “Pupils at all levels should investigate and understand relationship between the planet Earth and its solar system, galaxy, and universe” (p.106).

Another example, in the USA, the National Research Council (NRC) deals with the National Science Education Standards. NRC (1996) defines the

outline that involves the rules for effective classroom, age-appropriate guidelines for curriculum material development, authentic assessment procedures, and professional development programs for teachers. Moreover, it defines the specific learning objectives and suggests eleven major astronomy objectives for the K-12 astronomy (Adams, & Slater, 2000, p.1). In the NSES, there is a discrimination of the astronomy topics according to the age-level. There are tree main appropriate age-levels that are defined by the NRC. These are K-4, 5-8, and 9-12 grades. The objectives with respect to age-levels are identified and explained by the NSES as follows:

For K-4 level, the objectives focus on the describing the properties, locations, and notions of the sky objects with respect to the geocentric (Earth-centered) point of view. The NSES concentrates on the process instead of facts. Knowing the names and the order of the planets at the knowledge level is only the first step in an astronomical knowledge base and therefore must not form the core of the learning objectives (Adams & Slater, 2000, p.5). For this reason, at the K-4, it is appropriate for students to observe and chart the changing phases of the Moon rather than to memorize the phases. The NSES emphasizes that they should avoid expecting students to create mental models of the abstract geometry of the Sun-Earth-Moon system since teaching geometrical and abstract astronomy is inappropriate in the early grades. Similarly, seasons should be studied by using a geocentric point of view.

For 5-8 grades, the expectation of the NSES from students is to describe the solar system from a heliocentric (the Sun-Centered) perspective. Students should explain the phenomena of day/night, seasons, eclipses, and lunar phases by using a heliocentric perspective. Moreover, students should compare and contrast the solar system objects in terms of terrestrial/non-terrestrial, satellite systems, rotation/revolution, size/mass, and additional characteristics that students find important (Adams & Slater, 2000, p.6). Furthermore, NSES (1996) advices that the concepts of gravity should be introduced at the 5-8 grades level. An accurate model of a spherical Earth that explains gravity effecting on Earth's surface and tides should be understood by students clearly. Also, students should understand the effect of gravity on the

planets; moreover, heliocentric study of solar-system notions also should be taught at this level.

For 9-12 grades, the objectives concentrate an observation, origin, evolution, and characteristics of the universe beyond the solar system. Students should have an idea about the current scientific expectations of the origin and evolution of the Earth, the Solar System (nebular hypothesis), the elements (nucleosynthesis), and the Universe (the Big Bang). Moreover, at this level, exotic objects such as neutron stars and black holes are taught by observational and theoretical evidences.

There are different kinds of astronomy programs within science standards in different states in the USA. These programs are parallel with National Science Standards. Science Standards of all states define the astronomy objectives in the light of the National Science Standards. These objectives are determined according to the grade levels. There are some examples taken from states' curricula in Appendix A.

Kendall, DeFrees and Richardson (2003) have prepared the sequenced benchmarks for K-8 Science for the U.S Department of Education. It includes more specific standards such as K-2, 3-5, and 6-8. They mention that a significant number of states do not have such grade-by-grade distinctions in standards. They also assert that content must be assigned to a grade since it must be taught at a specific grade. Although there is not a sufficient research to assign a specific content to a specific grade, there is enough information about the sequence of the content presented in the curriculum. Besides, they demonstrate Atlas of Science Literacy (2001) published by American Association as a reference for the Advancement of Science.

The Atlas involves conceptual strand maps that emphasize "students' growth, understanding, showing how ideas and skills that student learn in different grades and topics depend on and support one another" (Kendall, DeFrees & Richardson, 2003, p.1). Two evaluation reports are used by them in order to identify the appropriateness of the science content. The first one is "Making Standards Matter" published by the American Federation of Teachers

involving ratings of the states standards, and the second one is "The State of State Standards in Science" published by Fordham Foundation. Moreover, California's Science Content Standards: Grades K-12, Ohio's Model Competency-Based Science Program, South Carolina Science Curriculum Standards: K-8 Science Standards, and South Dakota Science Standards are used as documents to identify objectives at each grade. There are tree main topics organized by sub-disciplines in the sequenced benchmarks for K-8 Science document. These are "Earth and Space Science", "Life Science", and "Physical Science". There are 26 topics in the document. Topics related with the astronomy are placed in the topic of "Earth and Space Science". Within the "Earth and Space Science", there are eleven topics, but eight of them directly related with astronomy are taken (See Appendix B).

American Association for the Advancement of Science (AAAS) (1993) also determines some criteria to teach astronomy topics in elementary and secondary schools. AAAS asserts that it is crucial for all students to develop a sense of the context of place, time and physical interactions in which their lives occur. Also, it mentions that curriculum should concentrate on experiences and ideas, and it should build in precursors to eventual understanding. For this reason, there is an arrangement of the topics according to benchmarks for any section. Moreover, these benchmarks are deeply analyzed by Project 2061. In Project 2061, there is physical setting section as a content part, and it includes seven benchmarks such as, 4A: The Universe, 4B: The Earth, 4C: The Processes that Shape the Earth, 4D: The Structure of Matter, 4E: Energy Transformations, 4F: Motion, 4G: Forces of Nature. Furthermore, there is an explanation of the teaching of each section according to the grade level. Each section is taught by spatial and longitudinal point of views. For example, "The Universe" section is taught by the beginning of Kindergarten to Grade 12. AAAS (1993) determines some objectives- constituting the base of Project 2061- about astronomy for appropriate grade levels (See Appendix C).

Moreover, there are many examples of the countries having the astronomy program. For instance, New Zealand Science Curriculum includes the standards related with the astronomy topics. In the New Zealand Science

Curriculum, the astronomy topics are located in the main courses as sub-objectives. It includes five main parts: “Making Sense of the Nature of Science and its Relationship to Technology”, “Making Sense of the Living World”, “Making Sense of the Physical World”, “Making Sense of the Material World”, and “Making Sense of Planet Earth and Beyond”. There are eight levels under the title of the “Making Sense of Planet Earth and Beyond” in the New Zealand Science Curriculum, and there is specific achievement objectives for each level. However, there is no independent or autonomous identification of the astronomy objectives in each level (See Appendix D).

Another example can be given from Canada. The curriculum is determined according to the needs of the states in Canada. There are many states curricula in Canada, and each of them determines its curriculum considering both the national and local needs and interests. One of them is Alberta state science curriculum that reflects the Canadian science education. The state of Alberta has a science curriculum from Kindergarten to Grade 12. In this curriculum, the place of the topics is determined according to the grade levels. There is elementary program between Grade 1 and 6, junior high school program between 7 and 9, and senior high school program between 10 and 12. For each grade level, sets of skill and attitude expectations are identified by the curriculum authority. The structures are identified for each program.

The elementary science program is designed as a series of five topics for each level, and according to the program; topics can be developed separately or linked to other topics and other subject areas. Also, the instructional plan may cause the change of the orders of the topics. There is an investigation of the astronomical concepts in grade level 1 and 6; therefore these topics are taken as a sample. According to the program, Seasonal Changes are taught in grade level 1 and Sky Science is taught in grade level 6 (See Appendix E).

Junior high school program of the Alberta is similarly based on the elementary science program, and in Grade 7, Grade 8, and Grade 9, there are five units, and each unit consists of four main components; “unit overview”, “focusing questions”, “key concepts”, and “outcomes”. “Planet Earth” is taught

in grade level 7 and “Space Exploration” is taught in grade level 9. “Planet Earth” includes the identification of the Earth’s landforms and materials, discovering patterns in the nature, distribution of the Earth’s materials, and developing models for geologic structures and processes. This topic mainly discusses learning of the structure of the Earth that can be considered as a part of the geography. In Grade 9, “Space Exploration” unit is mainly related with the study of space and use of the space environments. The format of the unit obeys the general format of the program. In order to organize the unit, four steps are followed regularly. These are “overview”, “focusing questions”, “key concepts”, and “outcomes” (See Appendix F).

It is obvious that the astronomy topics are placed under the Earth and Space Science that includes such fields of study as geology, meteorology, and astronomy in the curriculum of the Alberta that reflects the main curriculum framework of Canada.

2.5. Comparison of Various Countries Curricula with the National Science Curriculum of Turkey with Respect to Astronomy Objectives

When these curricula are compared with the Turkish Educational System, there are some similarities and differences among them. It is obvious that in Turkish Education System, the astronomy objectives are placed in the main courses such as social sciences, natural sciences courses in elementary schools grades between 3-8. However, Tunca (2002) also mentions that there are not any astronomy subjects within neither an independent course nor other main courses in secondary school education. On the other hand, in 1992 the Ministry of Turkish Education tried to design an astronomy elective course in the secondary schools, which occasionally came in practice.

A comparison of the national science and education standards of different nations with the national science curriculum of Turkey with respect to astronomy objectives can be summarized in Table 2.5.1.

Table 2.5.1.Summary of Comparison of the National Science and Education Standards of Various Countries (NSESVC) with the National Science Curriculum of Turkey with Respect to Astronomy Objectives

Grade level	NSESVC Astronomy Objectives	Objective in Turkish National Science Curriculum
K-4	• Locations, motions and properties of sky objects (from geocentric perspective) • Sun, moon, stars, clouds, birds, and airplanes • Effect of the Sun on the Earth (e.g. providing the light and heat necessary to maintain the temperature of the Earth) • Patterns of movement objects in the sky (pattern of the Sun, and Moon)	• Identification of the space • Movement of objects in the sky • Properties of the sky objects
5-8	• The position of the Earth in solar system • Identification of the solar system; Moon, eight other planets, and their moons, and smaller objects (asteroids, and comets) • The Sun as a central and largest body in the solar system • Regular and predicable motion of the objects in the solar system • Motion results; the day, the year, phases of the Moon, and eclipses • Gravity as a force • The role gravity force in the solar system • The role of gravity on the Earth • Explaining the phenomena of the tides by gravity • The Sun as a source of energy that effects on the Earth's surface e.g. plants, ground, ocean current, and water cycle • Seasons result from variations in the amount of The Sun's energy hitting the surface; the tilt of the Earth's rotation on its axis; the length of the day	• Investigation of the space (formation of the Sun, its layer and structural characteristics; motion of the objects in the solar system, hypothetical ideas of formation of the universal, space science, a new innovation in space technologies, and space pollution) • Galaxies • Stars (The Sun, formation of the star, layer of the star and its structural characteristics, motion of the star; solar system, planets, and their moons; lunar and Sun eclipses) • Comets, Asteroids, and Meteors • Staring at the space • Formation of the universal • Space technology; spacecraft, artificial satellites, and space station • Space investigation; first step on the Moon, live on the Moon, and space pollution

Table 2.5.1 (cont'd)

9-12	• Nebular cloud of dust and forming of the universal • Evolution of the Earth • The origin of the universe • The bing-bang theory • Expanding of the universe • History of universe matter • Trillions of stars, billions of galaxies, and theirs borne • Visible mass in the universe • Stars energy from nuclear reaction, structure of the stars • Fusion of hydrogen to form helium	Not included

2.6. Summary of the Literature Review

There is a broader range of definitions of the word curriculum, yet in summary, it includes total school experiences (Bishop, 1995; Saylor & Alexander, 1964), total planned activities (Doğan, 1975), valid learning activities (Ertürk, 1982), principles of teaching and learning (Elliot, 1991), everything that allows realizing national and instructional goals (Varış, 1994), everything that is taught in-schools and out of schools (Demirel, 2004; Oliva, 1992).

Bishop (1995) defines eight main factors that effect the determination of the curriculum as society, culture, philosophical issues, political issues, language, knowledge, psychological issues, and financial priorities and constrains.

The role of needs analysis is more important during the development of a curriculum. National needs (Ayaş, Çepni & Akdeniz, 1993; Parker, 2003; Williams, 1969), knowledge factors (Phenix, 1964), organization and arrangement of the concepts and principles (Bruner, 1966; Hamilton, 1976; Henson, 1995; Knight, 2001; Tyler, 1949), psychological issues (Bishop, 1995; Piaget, 1954; Whitehead, 1970), and the role of teachers (Elliott, 1991; Joyce, Calhoun, & Hopkins, 1997; Leat, & Higgins, 2002; Squire, Makinster, Barnett,

Luehman, & Barab, 2001; Stenhouse, 1975; Yiğit, 2002; Yüksel, 2003) are the most important components of the curriculum development. Those components play a crucial role in a curriculum development. However, curriculum development consists of mainly four steps. Those are planning (identifying the key issues and trends in the specific content area, assessing the needs and issues), developing (articulating the philosophy of the program, defining the grade level and course goals, developing the course objective, developing the assessment instruments to measure students' progress), implementing, and evaluating the program.

It is obvious that planning part, especially assessing the needs and issues is the critical part at the beginning of the curriculum development. In order to develop an effective curriculum model, the curriculum developers should consider opinions of the teacher, administrators, students, and parents. Also they should determine the main needs of the stakeholders in order to reach the desired outcomes or expectations of a program with high quality. The information is commonly gathered through surveys, interviews, and the applied inventory tests.

The same procedure is involved in developing all types of curriculums. Likewise, for developing an astronomy program or curriculum, the similar steps need to be followed. However, astronomy is generally thought as a part of the science curriculum. There is no sufficient study about preparation or development of a separate astronomy program in both international and national arena. Moreover, the studies related with the astronomy education are not plenty in the global perspective. The studies related with astronomy education are mainly based on misconceptions in astronomy (Baxter, 1989; Callison & Wright, 1993; Dai, 1991; Mali & Howe, 1979; Nausbaum, 1979; Osborne & Gilbert, 1980; Philips, 1991; Reed, 1972; Sadler, 1992; Schneps 1987; Skamp, 1994; Slater, 1993; Sneider & Pulos, 1983; Treagust & Smith, 1989; Vosniadou, 1992), concepts of the day and night (Frayer, Schween-Ghatala & Klausmeier, 1972; Rollins, Dentton & Janke, 1983), cause of the seasons (Atwood & Atwood, 1996), perception of the sky objects (Chamlis, 1990; Lightman & Sadler, 1993), Sun-Earth-Moon relations (Taylor, Barker &

Jones, 2003), origin of the evolution of the Earth and Universe (Philips, 1991; Roettger, 1998), mental model of students about the astronomical phenomena (Barnett, 2003;Vosniadou & Brewer, 1994). However, the studies that included gathering the opinions of the students and teachers about the content, the teaching and learning methods, the evaluation process, the learning environment, and facilities of the astronomy objectives are limited as a context of needs analysis. Systematic approach for the astronomy education should be developed by using all the components of curriculum development.

Most countries have astronomy standards as a part of their curricula such as Britain (Department for Education and Employment, 1999), North America (National Research Council, 1996), Australia (Board of Studies, 1998), Canada, New Zealand (Ministry of Education of New Zealand, 1993), and most European countries have their own standards, also they include frameworks to design curriculum for K-12 astronomy education.

Most of countries construct their astronomy standards for K-12 in their curriculum. However, there is no similar improvement in the National Science Curriculum of Turkey. It is observed that in Turkish Education System, the astronomy objectives are included as parts of the main courses of elementary education. However, Tunca (2002) also supports that there are not any astronomy subjects neither within an independent course nor in the other main courses in secondary school education. Moreover, there is no research to define the opinions and point of views of the academicians, astronomy lecturer, teachers, and students about the necessity of the astronomy program in Turkey. There is a similar gap in the literature for the astronomy education in Turkey. For this reason, a research is needed to study on and define the necessity of the astronomy program in Turkey, also a research is needed to make needs analysis in order to collect the data to develop the most accurate astronomy program.

This study mainly aims to investigate the astronomy programs used in various countries in order to see the national curriculum framework of the various nations about the astronomy education standards and to compare the different nations' curriculum frameworks of astronomy standards with the astronomy education of the national science curriculum of Turkey, and to view

the opinions of the elementary and secondary school students and teachers about the content, the teaching and learning methods, the evaluation process, the learning environment and facilities, and the significance of the astronomy course so they can be used to develop an astronomy program for Turkish elementary and secondary schools.

CHAPTER 3

METHODOLOGY

3.1. Overall Design of the Study

In this study, cross sectional survey research design was used as the requirement of research problem. Cross sectional survey is based on collecting information from a sample at one point in time. The purpose of this survey is to examine the general characteristics of international astronomy programs and to define the similarities and differences between these programs and the astronomy subjects in our national science program; to collect the opinions of the elementary and secondary schools' students and teachers about the content, the teaching and learning methods, the evaluation process, the learning environment and facilities, and the significance of the astronomy course in order to develop an astronomy program for Turkish elementary and secondary schools in the context of the needs analysis; to analyze the relationships between the demographic features of elementary and secondary schools students and their preference of astronomy.

3.2. Population and Sample

Population of the study is all public elementary and secondary schools in different locations of Ankara. These locations are Keçiören, Çankaya, Yenimahalle, Altındağ, Mamak, and Sincan districts of Ankara. The samples include both elementary and secondary schools students and the number of students in the samples were 3313. Elementary (See Appendix G) and secondary (See Appendix H) schools were selected according to the students' number in six locations in Ankara.

The number of schools, classes and students taken from six locations according to school types in Ankara are given in Table 3.1.

Table 3.1. Number of Schools, Classes and Students According to School Types

School Type	# of Schools	# of Class	# of Students
Elementary Schools	35	70	2133
Secondary Schools	20	40	1180
Total	55	110	3313

Number of elementary and secondary schools, number of classes in each school, and number of students in the population were taken from the Ministry of National Education. All schools in the six locations in Ankara were organized according to the districts. And then, with the help of a scientific calculator, the schools were selected randomly. This procedure is known as stratified-cluster random sampling. For the study, only regular public schools were selected in each district in Ankara. The total number of elementary and secondary schools in each district, the number of schools selected for the study, and the percentages of the selected schools are given in Table 3.2.

Table 3.2. Number of Total and Selected School of Elementary and Secondary School Students and Percentage of the Selected Schools for Each District

School Types	# of All Schools	District	# of Schools in Each District	# of Selected Schools in Each District	% of Selected School in Each District
Elementary Schools	244	Keçiören	36	8	22
		Çankaya	23	7	30
		Yenimahalle	27	5	19
		Altındağ	26	5	19
		Mamak	15	5	33
		Sincan	17	5	29
Secondary Schools	118	Keçiören	18	4	22
		Çankaya	26	5	19
		Yenimahalle	16	4	25
		Altındağ	10	2	20
		Mamak	14	3	21
		Sincan	5	2	40

We planned to have two classes from the each elementary school. Those were one from 5^{th} and one from 7^{th} grade levels. However, some schools did not have neither 5^{th} nor 7^{th} grade level classes in that case, we chose one class from 8^{th} grade levels. We went to the schools and asked for available classes. The number and their percentages of the elementary schools students according to the grade levels are given in Table 3.3.

Table 3.3. Number and their Percentages of Elementary School Students According to the Grade Levels

Grade Level	# of Students	%
5th	971	45.5
7th	1017	47.7
8th	145	6.8
Total	2133	100

The same steps were used for the selection of the secondary schools like the elementary schools. But, we have chosen10th grade level students in this case. When choosing the secondary school students, three different secondary school types were used for this study. These were Regular Secondary Schools (RSS), Secondary Schools with One Year English Preparation Class (SSPC), and Anatolian High Schools (AHS).

Regular Secondary Schools (RSS):

These schools offer programs lasting at least three years and preparing students for higher education in keeping with the objectives of Turkish national education. (YÖK, 2006)

Secondary Schools with One Year English Preparation Class (SSPC):

These schools were established with the aim of preparing high achieving students for higher education programs which correspond to their interests, abilities, and level of achievement; providing more effective foreign language teaching; raising the level of general secondary education; providing more extensive foreign language instruction. The period of study at these schools is 4 years, with the first year being devoted to an intensive foreign language preparatory program. (YÖK, 2006)

Anatolian High Schools (AHS):

Anatolian high schools are selective institutions that were established with the aim of preparing students for higher education programs which correspond to their interests, abilities, and level of achievement; providing more effective foreign language teaching; ensuring more efficient education through use of a foreign language as the medium of instruction. These schools offer a four-year program (a language preparatory program prior to the three-year high school education) using a modern European language, usually English, as the primary language of instruction in certain subjects such as science and mathematics. The demand for places in Anatolian high schools is high and admission is through a very competitive entrance examination. Graduates are generally very successful in the university entrance exams. (YÖK, 2006)

The number and their percentages of the secondary schools students according to the school type are given in Table 3.4.

Table 3.4. Number and their Percentages of Secondary School Students According to the Grade Levels

School Types	# of Students	%
RSS	545	46.2
AHS	413	35.8
SSPC	222	18.8
Total	1180	100

Moreover, the number of teachers in the sample was 37. The teacher population of the study is all the teachers of the science / physics classes in which we applied our questionnaire. The number and percentages of the teachers that were given the questionnaire according to the school types are given in Table 3.5.

Table 3.5. Number and Percentages of the Teachers According to the School Types

School Types	Total # of Teachers	# of Teachers	% in the Total
Elementary School	70	26	37
Secondary School	40	11	28
Total	110	37	34

3.3. Instrumentation

3.3.1. Data Collection Instruments

Tree instruments were used in this study. The first one called “A Questionnaire to Determine the Teachers’ Opinions about the Development of the Astronomy Program” (Q-DTO) was used to obtain data about opinions of elementary and secondary schools’ teachers on the development of an astronomy program, on the subjects of astronomy, and on its education, the second questionnaire called “A Questionnaire to Determine the Elementary Students’ Opinions about the Development of the Astronomy Program” (Q-DESO) was used to assess opinions of the elementary school students about the development of the astronomy program, and the last one called “A Questionnaire to Determine the Secondary School Students’ Opinions about the Development of the Astronomy Program” (Q-DSSO) was used to assess

opinions of the secondary school students about the development of the astronomy program. These instruments were developed by the researcher for the need analysis in order to collect data about the opinions of the participants towards astronomy and its education.

In order to develop all questionnaires, the interview protocol was prepared by the researcher. It was developed for interviewing the academicians and the astronomy lecturer in universities so as to take their opinions and suggestions about the development of survey questionnaires. It was investigated by many academicians and astronomy lecturer in universities in order to get feedback about the weakness of it and the parts needed to be improved. For this aim, interview protocol was given to two academicians whose research areas are astronomy in department of Physics in the Middle East Technical University to gather their opinions about the questionnaires. They are assistance professors in the university, they have at least five years experiences as an instructor in the university, and they give astronomy courses that include the issues especially related with philosophical and historical development of the astronomy concepts and contemporary issues related with the astronomical phenomena.

The interview protocol involved seven specific questions in order to take feedback from academicians and astronomy lecturer in universities about the development of survey questionnaires. The first question was asked to learn at which levels the astronomy topics should be taught. The second question was inquired to investigate what kind of aims should be considered when preparing an astronomy curriculum. The question three was used to identify the necessity of the needs analysis and what were the areas that must be considered while doing this analysis. Also, Question four's aim was to determine the criteria considered during the planning of the astronomy curriculum. Questions five and six were asked to gather opinions about the infrastructure of the astronomy curriculum such as adequate knowledge of instructors, quality of instructors, teacher profiles, and methods of teacher training. Lastly, question seven was used to obtain opinions from the interviewees about the benefits of

the astronomy curriculum with respect to national and social expectations (see Appendix I).

When the initial version of the Q-DTO, the Q-DESO and the Q-DSSO were developed, many academicians and astronomy lecturer in universities gave their suggestions and criticism during the development of the teachers' and students' questionnaires. The initial version of the Q-DTO, the Q-DESO and the Q-DSSO were sent to academicians interested in astronomy education by the way of e-mail, also answers and suggestions were collected in this way such as academician from the department of the astronomy of Ankara University and academician from department of art and science of İstanbul Kültür University. The academician from İstanbul Kültür University is a professor in the art and science faculty, his interested areas are basically associated with astronomy education and he supports astronomy education in each step of the education period of the students and wants astronomy to become widespread in the national education program in Turkey. The academician from Ankara University is an assistance professor in the department of astronomy and space science. He gives Statistical Astronomy and History of Astronomy courses at Ankara University in Turkey. Their comments and feedback were used during the preparation of the questionnaires by the researcher.

The initial version of the Q-DTO involved checklists, ranking and free responses items. There were completely twelve questions (directions) in this questionnaire. The first question (Direction 1) was asked to learn how the astronomy topics can be given (under a separate or an existing course) in each given grade level, the second one (including Direction 2 and 3) was used for collecting information about the necessity of the given astronomy subjects and getting opinions about the appropriate grade level for each subject to be educated, the fourth one (Direction 4) was an open-ended question which aimed to find out if teachers want to teach any astronomy subjects other than the ones given in the third direction. The fifth one included rank items that were used for ranking the preferences of teachers about the teaching and learning methods in the astronomy course, evaluation process in the astronomy

course. The sixth one involved open-ended questions items that were added to learn teachers' opinions and reasons about the learning environment and facilities, and the significance of the astronomy course.

Moreover, in this questionnaire, five crucial dimensions were considered when writing the items. These dimensions are given in Table 3.3.1.1.

Table 3.3.1.1. The Dimensions in the Initial Version of the Q-DTO

Dimensions	Direction
the significance of the astronomy course	1, 6.1 and 6.2
the contents	2, 3, 4, 6.4
the teaching-learning process	5.1, 5.2, and 5.3
the evaluation	5.4
the learning environment and facilities	6.3

(See initial version of the Q-DTO questionnaire in Appendix J)

The initial version of the Q-DESO and the Q-DSSO included checklists, ranking and free responses items. Checklist questions were used for collecting demographic information of the participants. Ranked items were used for ranking the preferences of participants related with astronomy education. Free response items were also added to learn students' opinions and reasons.

There were totally thirteen questions (directions) in these questionnaires and there were five main parts. The first part was prepared to gather the demographic information of the participants. In this part, questions were asked to assess the gender, the grade levels, the parents' education status, and the school types of the primary and secondary school students.

The second part was prepared to learn the students' preferences about the astronomy. The question was "How is astronomy preferred to be learned?"

There was a checklist for this question and students are asked to put a check next to the preferred choice and give the reason why he or she selected that choice.

The third part consisted of the astronomy topics determined by astronomy teachers, academicians and expert. The question was “Do you want to learn these astronomy topics? Put a check in the positive column next to the topic that you want to learn, and put a check in the negative column next to the one that you do not want to learn, and if you have a reason for your selection, write your opinion on the given space.”

The fourth part involved an open-ended question which aimed to find out if the students want to learn any astronomy subjects other than the ones in the third part. The question was “Are there any other astronomy subjects that you want to learn and which are not mentioned in the previous part. If there are, write their names and why they should be included.”

The fifth part included ranked items that were used for ranking the preferences of participants about the teaching and learning methods in the astronomy course, evaluation process in the astronomy course, the learning environment and facilities in the astronomy course, the significance of the astronomy course.

Six crucial dimensions were considered, also in these questionnaires, when writing the items. These dimensions are given in Table 3.3.1.2.

Table 3.3.1.2.The Dimensions in the Initial Version of the Q-DESO and Q-DSSO

Dimensions	Direction
the demographic characteristic of the students and their preference of the content of the astronomy course	1
the significance of the astronomy course	2, 5.5,5.6 and 5.8
the contents	3, 4, 5.9
the teaching-learning process	5.1, 5.2
the evaluation	5.4
the learning environment and facilities	5.3, 5.7

See the initial version of the Q-DESO in Appendix K and the initial version of the Q-DSSO in Appendix L.

All instruments passed on the pilot study, and some revisions were done by the researcher. Pilot study was applied in both elementary and secondary schools. In these schools, students in 5-7-8 grades took the Q-DESO. The sample size of elementary students was approximately 100 and the sample size of the secondary school students was about 40 in the pilot study. The Q-DSSO was given to the students in the 10^{th} grade level in these schools. Moreover, the Q-DTO was given to the teachers in these schools.

At the end of the pilot study, the questionnaire named by the Q-DTO was altered on a small scale. The main revision was done about the question that is related with the selection of the preferred astronomy topics (Direction 2 and 3) that are wanted to be seen in astronomy courses. This question included 32 items and their reasons. The pilot study showed that many items were not necessary; therefore, the number of the items was decreased to 18 items, and many lengthy items were shorted with the help of the advice of the astronomy lecturer in universities on astronomy topics. Furthermore, the format of the questionnaire was revised by the researcher. The typing size of the words, writing characters of the sentences, readability of the sentences and exterior appearance of the questionnaire were rearranged by the researcher. Finally, the revision of the questionnaire was completed successfully (See the final version of the Q-DTO in Appendix M).

The Q-DESO and the Q-DSSO were changed on a large scale. The results showed that both the format and the content of the questionnaire needed to be revised by the researcher. Also, students had misunderstood some parts of the questionnaire. First of all, the language clarity and grammar coherence had to be arranged by the astronomy lecturer in universities, which were completed by the Turkish language teachers in one week. After that, some ambiguous and unclear directions were rearranged and revised by the researcher. There were unrelated and undesired answers that were given by the students for many

questions because of the unclear directions. There was a need to add those kinds of questions more detailed information by the researcher. There were unnecessary and complex questions in the questionnaire that were also rearranged by the researcher. For example, the last five questions were open-ended questions in the questionnaire; however, the majority of the students did not write any opinions or suggestions about the questions. For this reason, selection-type items were added for each question and students were asked to select appropriate choices by ranking them in an order.

Another revision was done about the question of the selection of the preferred astronomy topics that are wanted to be seen in astronomy courses. This question included 16 items and their reasons. The pilot study showed that many items were not touched by the students; therefore, the number of the items was decreased to 14 items, and many lengthy items were shorted with the help of the advice of the astronomy lecturer in universities on astronomy topics. Lastly, the format of the questionnaire was revised by the researcher. The typing size of the words, writing characters of the sentences, readability of the sentences and exterior appearance of the questionnaire were rearranged by the researcher. Finally, the revision of the questionnaire was completed successfully (See the final version of the Q-DESO in Appendix N and the Q-DSSO in Appendix P).

3.3.2. Data Collection Procedures

The purpose of this study is to gather the opinions of the elementary and secondary schools' students and teachers about the content, the teaching and learning methods, the evaluation process, the learning environment and facilities, and the significance of the astronomy course in order to develop an astronomy program for Turkish elementary and secondary schools in the context of the needs analysis.

Seven categories were formed under the main problem. These categories can be listed by: examining the various nations' astronomy programs, the opinions of the students and teachers about the content of the

astronomy course, the teaching and learning methods in the astronomy course, evaluation process in the astronomy course, the learning environment and facilities in the astronomy course, the significance of the astronomy course, and finally the correlation between demographic characteristic of the students and their preference of the content of the astronomy course.

For this aim, first of all, literature review of study started in the local and international research areas. The local search included searching Libraries, Bookstores, *OBES* and *ULAKBİLİM*, Journal of Hacettepe Education (*Hacettepe Eğitim Dergisi*), Journal of Education and Science (*Eğitim ve Bilim Dergisi*), Journal of National Education (*Milli Eğitim Dergisi*), *YÖK*-Thesis, and Local Congresses thoroughly. International search involved searching of University Libraries, International Congresses, Foreign Astronomy Curricula, and Catalogs Related with Astronomy Courses. The Internet was used to get information about the specific keywords. Internet research was divided into tree parts: Search engine (Google, Altavista, Infoseek, Yahoo, and *Arabul*), Databases and Indexes (ERIC, EBSCOhost, The Social Science Citation Index, Scientific Index, Online Indexes), and Books (such as Amazon) and Journals (such as Geoscience Education, Science Education, International Journal of Science Education, Journal of Research in Science Teaching, Journal of Education Policy etc.). The keywords related in this study were used: needs analysis, curriculum development, astronomy curriculum, and astronomy education.

Tree instruments were developed in the study. These instruments were the Q-DTO, the Q-DESO, and the Q-DHSE. Initial version of the questionnaires was developed with the suggestions and criticism of the astronomy lecturer in universities and academicians. These instruments were the Q-DTO, the Q-DESO, and the Q-DHSE. Initial version of the questionnaires was developed with the suggestions and criticism of the astronomy lecturer in universities and academicians. These instruments were developed in a pilot study. After this study, they were revised, and necessary changes were made to be applied to a larger sample.

After completing the revision of the questionnaires, the next step was to define the population and select the sample. The population of the study was regular elementary and secondary public schools in Ankara. In order to find out the population size, the data of the elementary and secondary schools was requested from the Ministry of National Education. After selecting the schools and classes in the population, we applied the Ministry of National Education to get permission to use the questionnaires in the selected schools. The Ministry of National Education gave the permission 8 weeks later, after that the data collection process started immediately by the researcher.

The Q-DTO and the Q-DESO and the Q-DSSO questionnaires were used as a data collection instrument. Data collection period was completed in 10 weeks. In this period, the researcher conducted his survey in the 110 classes and reached 3313 participants which include 35 primary and 20 secondary school students and 37 teachers. The researcher went to each school with the permission paper without taking appointment. Firstly, the school administrator was visited and after checking the paper, the researcher was guided to a science or physics teachers. The questionnaires were applied in these teachers' classes. In the classes, the teacher questionnaire was given to the teacher and the questionnaires for the students were distributed to each student. Later, the importance and goals of the questionnaire were explained to the participants and forty minutes (one lecture hour) was given them in order to fill in the questionnaire. No significant problem was faced during the application period and the necessary data was received from the teachers and students successfully.

Cross sectional survey was used for data collection strategy. The researcher went to the schools and applied the questionnaires by himself. This method was difficult for the researcher because of its requiring time and hardness of finding participants, but this method is more efficient than mail, telephone and interview methods when population size and samples are considered. Of course, cross sectional surveys also have strengths and weaknesses, but they are more appropriate when dealing with large sample of participants and allow eliminating the bias and misunderstandings of the

participants about the general objectives of the questionnaire. Also, they provide continuum of the participants' attraction and interest for the questionnaire with the help of trained administrator (In this study, it was me).

The data collected from this sample were analyzed to determine the dimension of the needs that could be used in the development of astronomy program for elementary and secondary school students.

3.4. Data Analysis

After that, collected data were recorded on the computer as an excel document. While recording the data, the questionnaires which were filled in a wrong way were eliminated from the study. The collected data were transferred to the computer in about 12 weeks; then these data were transferred to SPSS (Statistical Package for the Social Sciences) program from MS-Excel to do descriptive statistics. In this analysis, frequencies, percentages, means, standard deviations, and medians of answers of participants for each question were calculated and analyzed according to the question types in the questionnaires.

3.5. Ethics

In this study the aim of the questionnaire was to collect the students and teachers' opinions. There might have a possibility of discomfort of participants while giving their opinions about the questions in the questionnaire. For this reason, the following precautions were taken. During data collection, an atmosphere where participants could present their opinions honestly in the questionnaire was created with the presence of the researcher in the classes. Besides, the participants might have preferred to be taken their opinions in secrecy and in confidence. For this reason, names were not demanded for the participants. Possibility of deception problem was overcome by explaining the aim of the study on the front-page of the questionnaires, and in order to eliminate peer and teacher influence, the researcher was present as an observer in each class.

3.6. Assumptions and Limitations

The first limitation that it was assumed to reach only 5th and 7th grade students, yet in some schools the classes in these grades did not have classes when the researcher went there to apply the questionnaires. For this reason, although it was not taught to be included in the study, 8th grade students were given the questionnaire. This might have affected the results of the study in several aspects despite the small number of the 8th grade students. The last limitation was that students did no have the chance of answering the questionnaire whenever they want. They had to complete all the questions in the class in a limited time.

Moreover, the researcher did not see anything that makes us to think the participants were not honest and sincere in their answers. In addition, the study did not inquire whether the participants want to have an astronomy education in their courses or not, which means that in the questionnaire given to the students, the question “do you want to study astronomy subjects in your education?” was not included. It was assumed that all the students would like to have an astronomy education in their schools.

CHAPTER 4

RESULTS

4.1. Description of the Findings and their Discussion

The results of the data collected from elementary and secondary school students' and teachers' questionnaires are given in this section. The results of the study can be analyzed in the seven dimensions according to the sub-problems of the main problem. The first one was examining the various nations' curricula in terms of astronomy education and it was analyzed in the literature review in Chapter 2. Other six dimensions were investigated by analyzing of the data collected from the questionnaires. Those dimensions were listed by: the opinions of the students and teachers about the content of the astronomy course, the teaching and learning methods in the astronomy course, evaluation process in the astronomy course, the learning environment and facilities in the astronomy course, the significance of the astronomy course, and finally the correlation between demographic characteristic of the students and their preference of the content of the astronomy course. These dimensions were analyzed step by step in the three main parts. The first part included the analysis of the elementary school students' questionnaire result; the second part involved the analysis of secondary school students' questionnaire results; and the last part included the analysis of teachers' questionnaire results.

4.2. The Results of the Elementary Schools Students Questionnaire

a) Opinions of the elementary students about the content of the astronomy course

The crucial result was taken from the percentages of students' preference of the given astronomy subjects in the part tree in the Q-DESO (See Appendix N).These percentages showed that simpler and concrete astronomy topics became more popular for the elementary school students, while more abstract topics found place in the rank of staying behind. For example, the most favorite topics that were preferred by the elementary school students were the motion of the Sun and the Planets (85.4%), stars and huge celestial bodies (81.2%), the relationships of the Sun, the Earth and the Moon with each other (80.5%), virtual lines in the sky: horoscopes signs (78.6%) (Majority of the students accept that this subject has a place in astronomy), the motion of the Earth in a day and around the Sun (76.6%). On the other hand, although the percentages were grater than 50, the least popular subjects were other life forms and other solar systems (68.4%), mass gravity force and the effects of it on the objects (68.1%), history of Astronomy (66.6%), light and shadow (63.8%), the concept of time and calendars (60.9%). The percentages of the preferred astronomy subjects in elementary schools students' results are given in Table 4.2.1.

Table 4.2.1.The Percentages of the Preferred Astronomy Subjects in Elementary Schools Students' Results

TOPICS		f	%
T.1.Light and shadow (Ex. The behavior of light. Forms of shadow)	M*	17	0.8
	N**	756	35.4
	Y***	1360	63.8
T.2.Mass gravity force and the effects of it on the objects (Ex. Gravity force and Tides)	M	15	0.7
	N	666	31.2
	Y	1452	68.1

Table 4.2.1 (cont'd)

T.3.The motion of the Sun and the Planets (Ex. The orbit of the Planets and their features)	M	12	0.6
	N	300	14.1
	Y	1821	85.4
T.4.The effects of the Sun on the life on Earth (Ex. The importance of the Sun as an energy source and its effects on the ecology systems on Earth)	M	20	0.9
	N	545	25.6
	Y	1568	73.5
T.5.The motion of the Earth in a day and around the Sun (Ex. The formulation of day and night. A year and seasons)	M	20	0.9
	N	480	22.5
	Y	1633	76.6
T.6.The relationships of the Sun, the Earth, and the Moon with each other (Ex. Solar and lunar eclipse)	M	26	1.2
	N	389	18.2
	Y	1718	80.5
T.7.History of Astronomy (Ex. Copernic. Kepler. Galileo. Tycho. Newton)	M	30	1.4
	N	682	32.0
	Y	1421	66.6
T.8.The concept of time and calendars	M	35	1.6
	N	799	37.5
	Y	1299	60.9
T.9.Telescopes, satellites and their usages	M	35	1.6
	N	522	24.5
	Y	1576	73.9
T.10.Space studies (Ex. Apollo. Hubble)	M	26	1.2
	N	492	23.1
	Y	1615	75.7
T.11.Stars and huge celestial bodies (Ex. Nebulas, galaxies)	M	34	1.6
	N	367	17.2
	Y	1732	81.2
T.12.Form of the Universe and its evolution (Ex. The birth of stars and galaxies. Their forms and evolution)	M	31	1.5
	N	511	24.0
	Y	1591	74.6
T.13.Other life forms and other solar systems	M	29	1.4
	N	645	30.2
	Y	1459	68.4
T.14.Virtual lines in the sky: horoscopes signs	M	20	0.9
	N	436	20.4
	Y	1677	78.6

Note: n= 2133

*Missing, **No, ***Yes

These results demonstrated that elementary school students preferred the uncomplicated and concrete astronomy topics rather than complex and abstract ones. Although elementary school students preferred the uncomplicated and concrete astronomy topics rather than complicated and abstract ones, there is a need to increase the interest level of these students in more abstract subjects such as history of astronomy, light and shadow, and the concept of time and calendars etc. Also, these results shows that astronomy topics to be taught to the elementary school students should be determined carefully keeping the grade levels and cognitive process development of the students in mind.

The fourth part of the Q-DESO involved an open-ended question which aimed to find out if the students want to learn any other astronomy subjects besides the ones in the third part (See Appendix N). The question was "Are there any other astronomy subjects that you want to learn and which are not mentioned in the previous part (in the third part of the Q-DESO). If there are, write their names and why they should be included." The additional preference of elementary school students about astronomy topics are listed from the mostly wanted topics to the less wanted topics in Table 4.2.2.

Table 4.2.2. Astronomy Subjects Added by the Elementary School Students

Main Topic	Subtopics
Astronomy	Definition of astronomy / Importance of astronomy / Field of astronomy
Astronauts	Who the astronauts are / Preparations of the astronauts before going to the space / Life of the astronauts in the space / Duties and jobs of astronauts in the space / Properties of astronauts' clothes / Criteria needed to be an astronaut / The way of nourishment of the astronauts in the space

Table 4.2.2 (cont'd)

The Moon	How the Moon appears at nights / Whether it rotates / How it exists / Why the Moon's appearance changes in a month / Reasons for lunar eclipse / Whether there is a gravity force on the Moon / Whether there are any life forms on the Moon / How people can travel from the Earth to the Moon / Effects of the Moon on the Earth / Reason of the brightness of the Moon / Characteristics of the soil on the Moon
The Earth	How the Earth exists / How and why the Earth rotates and why it is spherical / Why we do not feel the rotation of the Earth / How the appearance of the Earth looks like in the space / The distance between the Earth and the other planets / What relationships there are between the Earth and the other planets / How great the gravity of the Earth is / The layers of the Earth and their properties / Whether there is a planet bigger than the Earth / The importance of the Earth in the universe / What kind of objects rotate around the Earth / The evolution process of the Earth
Universe	What the universe is / How the universe took its shape / What the boundaries of the universe are / Whether there are any life forms in the universe / The way of living in the universe better / How many planets and stars there are in the universe / How the directions are determined in the universe / What the size and temperature of the universe are / How the universe expands / The structure of the universe
Galaxies	Formation and properties of the galaxies
Other Planets	Formation of the planets / Information about the planets / Life forms in the planets / Relationships between the planets and their satellites / Probability of traveling among planets / Weight of the planets / Unusual events in the planets / Size of the planets and distance among them / Comparison of the Earth to the planets
Sky	Formation of the sky / Prediction and comprehension of the sky objects' motion / Why sky is blue / How the sky hangs on the air

Table 4.2.2 (cont'd)

The Sun	Formation of the Sun / Distance between the Sun and the Earth / Properties of the planets in the solar system / Formation of the solar system / Reasons for the solar eclipse / Effects of the Sun in the universe / Bigger stars than the Sun / Solar energy / Reason for the rise of the Sun and sunset / The layers of the Sun and properties of each layer / The reason why the Sun warm the Earth but the Moon does not / Types of the beams in the Sun / Reasons why the Sun does not slide like the other stars
Mars	Properties of the Mars / Life forms on the Mars / Whether there is water on the Mars / The way to travel to the Mars
Space	What the space is, its shape, its size and its limit / What the space ship is and how it can be produced / For what space ships are used and which materials are used in the space ships / Kinds of space ships launched in the space / Space stations / Information about space clothes / Formation of the space / who the first person in the space was / Life of the astronauts in the space / How the space ships can come back the Earth / How a person can go out in the space / Information about space travel / Why space ships reveal the some of their parts when they launch and why some of them break into pieces in the air / Reason for lack of the gravity in the space / How a person and animals live in the space / How the astronauts move in the space / What kinds of materials and devices are used in the space / Whether there is an UFO in the space / Space studies and information about space garbage
Stars	Stars and its properties / Existence of the stars and their lifetime / Whether all stars are hot / How they turn into black holes / How they shine / Information about star systems / Why stars appear at night / How they hang on the air / What the shapes of the stars look like / Evolution of the stars / What a comet is and its properties

Table 4.2.2 (cont'd)

Others	Other solar systems / What the bing bang is / What a meteorite is and how it is formed / What the invisible light in the Earth is / How a day, a moth, and a year are originated / What light year is / What a black hole is and how it is formed / Global warming and its reasons / What the mass attraction force is / Milky way and its properties

The students are asked to write down about the demanding astronomy subjects that they study in their lessons in the last section of the Q-DESO. The question was "What are the astronomy topics, which are taught under Social and Science lessons, that you have difficulty in understanding? How should they be taught?" Approximately 700 elementary school students expressed their opinions related with the subjects they have difficulty. The results of the astronomy topics difficulties are given in Table 4.2.3.

Table 4.2.3. Astronomy Topics' Difficulties of Elementary School Students

Astronomy Topics	≈n
1. All of them are difficult because of lack of pre-knowledge about the astronomy subjects	25
2. Concepts of the time and calendars	25
3. Gravity force	25
4. Layers of the Earth	25
5. Light and shadows	25
6. The Milky Way and its properties	50
7. Optics (reflection and refraction of the light)	25
8. Rotation of the Earth	25
9. Solar and lunar eclipse	50
10. Solar system	50

Table 4.2.3 (cont'd)

11. Sound and light	25
12. Space	50
13. Stars and comets	25
14. Structure of the universe and its evolution	25
15. The distance among the planets	25
16. The effect of the solar and lunar eclipse on the Earth	25
17. The formulation of the day and night	50
18. The formulation of the seasons	50
19. The movement of the planets in the solar system	25
20. The order of the planets and their distance from the Sun	25
21. The reason of the sunset	25
22. The relationships among the planets	25

b) Opinions of the elementary students about the teaching and learning methods in the astronomy course

The students' expectations from an astronomy course to learn the subjects better are questioned in the Q-DESO. The direction was "Imagine that there is an astronomy course in your school; which one would be more necessary to you to learn the subjects better? Rank those from the most important one to the least important one giving each a number."

The rank of elementary school students' opinions about an astronomy course to learn the subjects better is given in Table 4.2.4.

Table 4.2.4. Rank of the Elementary School Students' Opinions about an Astronomy Course to Learn the Subjects Better

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean*	Median	Std. Dev.
CLEAR	2056	1	8	1	8	3.0	3.0	1.76
WITH_EXP	2055	1	8	1	8	3.5	3.0	1.84
SIMPLE_F	2056	1	8	1	8	3.6	3.0	1.90
DAILY	2047	1	8	1	8	4.1	4.0	1.98
TIME	2053	1	8	1	8	4.4	4.0	1.96
IN_RELAT	2047	1	8	1	8	4.5	5.0	2.10
PRE_KNOW	2042	1	8	1	8	5.1	6.0	1.75
OTHER	1982	1	8	1	8	4.8	6.0	3.23
Valid N (listwise)	2032							

* The small mean demonstrate the most favorable item, but large mean demonstrate the least favorable item.

The items in this sub-part and their abbreviations are as shown below:

Clear instructions and information (CLEAR)

Simple and clear experiments (WITH_EXP)

Simple formulations (SIMPLE_F)

Making connections with daily life experiences (DAILY)

Presenting the subjects in a sufficient period of time (TIME)

Presenting the subjects in relation with each other (IN_RELAT)

Eliminating the lack of pre-knowledge and misconceptions (PRE_KNOW)

The majority of the elementary school students regarded the clarity of the instructions and the information as the most important component to learn the astronomy subjects better. On the other hand, eliminating the lack of pre-knowledge and misconceptions was not given that much importance compared to the other components and was regarded as having the least importance.

Moreover, most elementary school students selected "other option" about this question; some of them thought that these choices were not enough to learn the subjects better. The following suggestions were collected from them:

1. Complicated subjects must be repeated again and again by the instructors until they are understandable
2. Instructors must spend a lot of time on problematical subjects
3. Qualified and astronomy lecturer must teach the astronomy subjects
4. There must be private rooms which are used for astronomy activities in the schools
5. There must be a conversation with the astronomy lecturer or the teachers periodically, number of lecture hours must increase in a week
6. Instructors must be cheerful and tender in the lecture, and the homework load must be reduced by the instructors.

Students' opinions about teaching and learning methods were asked in the Q-DESO and the direction was "With which teaching and learning methods would you like to learn astronomy subjects? Rank those from the most important one to the least important one giving each a number." Also they were asked to write the reasons for their responses. The rank of elementary school students' opinions about teaching and learning methods is given in Table 4.2.5.

Table 4.2.5. Rank of the Elementary School Students' Opinions about Teaching and Learning Methods

	N	Pos. Min.	Pos. Max	Min.	Max.	Mean	Median	Std. Dev.
EXPERMNT	2021	1	9	1	8	3.5	3.0	2.11
DISCUSS	2008	1	9	1	8	4.2	4.0	1.97
PROJECT	2013	1	9	1	9	4.3	4.0	1.99
COMPUTER	2015	1	9	1	8	4.3	4.0	2.57
GROUP	2008	1	9	1	9	4.3	4.0	1.89
GAMES	2011	1	9	1	9	4.8	5.0	2.31
INTEREST	2000	1	9	1	9	5.2	6.0	2.15
TEACHER	1999	1	9	1	9	5.3	6.0	2.65
OTHER	2099	1	9	1	9	7.1	9.0	2.84
Valid N(listwise)	1975							

The items in this part and their abbreviations are as shown below:
With experiments and observations (EXPERMNT)
Within a discussion and research environment (DISCUSS)
With preparing projects (PROJECT)
With computer – based techniques (COMPUTER)
With group work activities (GROUP)
With class games (GAMES)
With the activities designed according to your interest and knowledge level (INTEREST)
With teacher – centered methods (TEACHER)

The majority of the students taught that experiments and observations were the most important methods to teach and learn the subjects better. Following reasons were collected from the students' responses for this approach:

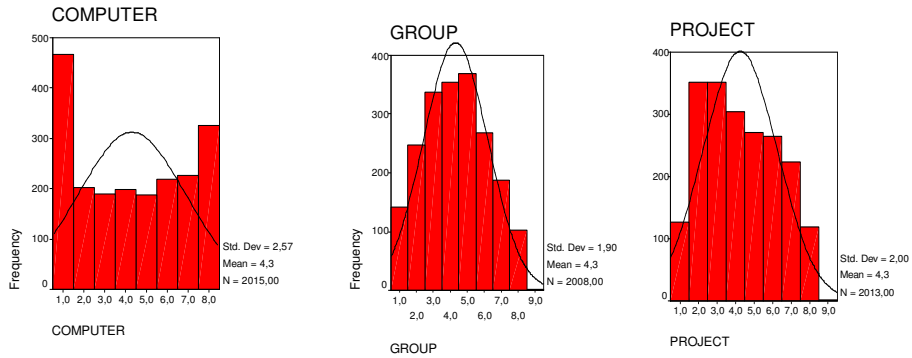
1. Easily and orderly arrangement of the information in mind
2. Consolidation of the knowledge with a practical approach
3. Allowing better understanding of the theoretical information
4. Allowing to store the information in long term memory with the help of experiments and observation
5. Causing better understanding of the information by making observation and progressing the psychomotor domain
6. Reaching the main goals with a more understandable, simple and fast way
7. Providing more amusing and funny atmosphere
8. Providing the realization of the knowledge
9. Providing a real learning far away from memorization
10. More efficient and better learning with observations and experiments than the other methods
11. Recalling information with no trouble in mind
12. Allowing the proof of the facts, and providing better understanding of the concepts and principles

Conversely, the teacher – centered methods were not given that much importance compared to the other components and were regarded as having the least importance. Following reasons were mentioned by the students for this approach:

1. Teacher based method is generally insufficient and incomprehensible
2. Mostly unqualified and different science field teachers try to explain the astronomy subjects
3. The participation of the students is low in this method
4. Memorization becomes more crucial in this method
5. The lecture is boring and drab
6. Teachers do not update their knowledge.

Although the means of the project, computer – based and group work activities methods means are equal, the distribution of the rank scale is different. That the standard deviation of them is high shows the wideness of the preference range of the each method. The means and standard deviation of the project, computer – based and group work activities methods are given in Table 4.2.6.

Table 4.2.6. Means and Standard Deviation of the Computer – Based and Group Work Activities Methods



The opinions of the elementary schools students about the ways to be followed when teaching the astronomy topics are given in Table 4.2.7.

Table 4.2.7. Opinions of the Elementary School Students about the Ways to be Followed when Teaching the Astronomy Topics

Ways to Learn Astronomy Topics Better	≈n
1. Clear and comprehensible explanation	100
2. Education condition including necessary devices and materials related with astronomy topics	25
3. Visiting museums including the astronomy devices and materials	25
4. Facilities allowing to observe the sky at nights	25
5. Amusing class environment where the topics arouse interest and attraction of the students	50
6. Learning the astronomy subject with the qualified and expert teachers	20
7. Learning the astronomy subjects more detailed, not with superficial and simple teaching methods	50
8. Considering appropriate grade level	25
9. Using simple, easy and understandable methods	50
10. Explaining the astronomy topics with the help of experiments, observations, games, projects, and models	50
11. Teaching the astronomy topics using computers, OHPs, films, slides, and photographs	50
12. Buying books and journals related with the astronomy topics	20
13. Class environment allowing discussion and cooperation between the teacher and the students	25
14. Environment that allows the students to do the research and investigation	20
15. Environment that include visual materials like TV and videos	25
16. Using the daily life experience related with the astronomy topics	20
17. Giving lots of attractive, interesting, and curious examples	25
18. Efficient classroom management	20

c) Opinions of the elementary students about the evaluation process in the astronomy course

The students' opinions about the evaluation process for an astronomy course were gathered with the Q-DESO. The direction was "Which of the followings would you like to see in the evaluation process for the astronomy course? Rank those from the most important one to the least important one giving each a number." The rank of elementary school students' opinions about evaluation process is given in Table 4.2.8.

Table 4.2.8. Rank of the Elementary School Students' Opinions about Evaluation Process

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
SKILLS	2052	1	6	1	5	2.8	3.0	1.34
CLASSWRK	2050	1	6	1	6	2.8	3.0	1.35
PROJECTS	2051	1	6	1	6	3.0	3.0	1.29
GRUP_OBS	2053	1	6	1	6	3.1	3.0	1.45
W_OR_EX	2053	1	6	1	6	3.2	3.0	1.61
OTHER	2100	1	6	1	6	5.2	6.0	1.72
Valid N (listwise)	2042							

The items in this part and their abbreviations are as shown below:
According to the skills of performance, observations and experiments (SKILLS)

According to the class work observation (CLASSWRK)

According to the results of projects work (PROJECTS)

According to the group work studies (GRUP_OBS)

According to the written and oral exams (W_OR_EX)

A great deal of students preferred to be evaluated with an evaluation process that includes testing according to the skills of performance, the observations and experiments. In other words, the majority of them supported performance based evaluation process. On the other hand, the written and oral exams were preferred the least, which indicates that the majority of the students do not favor these evaluation types.

Most of the elementary school students had a different point of view about the evaluation process of the astronomy course when we analyzed the "other option" part. The "other option" about the evaluation process can be categorized following way:

1. The evaluation must be done according to the homework, behaviors of the students in the class, students' participation, and attention and effort on the lecture.
2. Some of them thought that there must be no evaluation for this course.

d) Opinions of the elementary students about the learning environment and facilities in the astronomy course

The question was asked to learn the students' preference about the teaching – learning environment that they believed created better education environment. The instruction was "In what kind of a teaching – learning environment would you prefer to learn the astronomy subjects? Rank those from the most important one to the least important one giving each a number." The rank of the elementary students' opinions about the teaching – learning environment is given in Table 4.2.9.

Table 4.2.9. Rank of the Elementary Students' Opinions about the Teaching – Learning Environment

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
COORP	2060	1	5	1	5	2.1	2.0	1.12
GROUP_W	2060	1	5	1	5	2.3	2.0	1.00
TEACHR_B	2054	1	5	1	5	2.4	2.0	1.05
INDIVID	2053	1	5	1	5	3.2	4.0	1.02
OTHER	2064	1	5	1	5	3.7	5.0	1.68
Valid N (listwise)	2050							

The items in this part and their abbreviations are as shown below:
In an environment where there is a cooperation between teacher and students (COORP)
In an environment where group work activities take place (GROUP_W)
In an environment where teacher transfers the knowledge (TEACHR_B)
In an environment where individual work is basically done (INDIVID)

A greater number of students regarded the environment where there is cooperation between the teacher and the students as the most important component to learn the astronomy subjects better. Moreover, the group-work activities and the teacher's transferring the knowledge were other preferences of the students. It was obvious that students desired the cooperation approaches more than the individual ones. Most of the students considered the environment where individual work is basically done as the least important aspect.

Furthermore, when we summarize the students' opinions in the "other option" part of this question they prefer:

1. A teaching – learning environment including the conversation with well-informed people about the astronomy
2. Computer based training
3. Sufficient equipments and devices related with astronomy subjects

4. Deeper study and investigation laboratory
5. High technological devices to learn the astronomy subjects

The question was asked to learn the students' opinions about the most useful facilities for an astronomy course. The direction was "What kind of facilities should be provided for an astronomy course? Rank them from the most important one to the least important one giving each a number." The rank of elementary students' opinions about facilities that provided for astronomy course is given in Table 4.2.10.

Table 4.2.10. Rank of the Elementary Students' Opinions about Facilities that Provided for Astronomy Course

	N	Pos. Min	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
TV	2042	1	8	1	8	3.2	2.0	2.22
LAB	2043	1	8	1	8	3.4	3.0	1.82
OHP	2041	1	8	1	8	3.6	3.0	1.98
LIBRARY	2037	1	8	1	7	4.1	4.0	1.76
STORY	2036	1	8	1	8	4.3	4.0	1.83
JOURNAL	2030	1	8	1	8	4.6	5.0	1.82
DIALOG	2036	1	8	1	8	4.8	5.0	1.95
OTHER	2113	1	8	1	8	5.7	7.5	2.83
Valid N (listwise)	2021							

The items in this part and their abbreviations are as shown below:
Facilities that include devices like TV and videos (TV)
Facilities that include laboratories where there are materials and models related with astronomy subjects (LAB)
Facilities that include OHP and slides (OHP)
Facilities that provide doing research on astronomy (LIBRARY)
Facilities that include activities prepared with stories and scenarios that can be performed in class (STORY)

Facilities that include having a membership of a journal or a book related with astronomy (JOURNAL)
Facilities that provide a discussion environment where students can speak out their ideas related with astronomy (DIALOG)

According to most of the students, facilities including devices like TV and video were the first preference to learn the subject matters better. However, it had a great standard deviation which reflected that the selection scale of this item is either the first or the last choice. In addition, they considered that laboratories, OHP and slides were crucial components coming after TV and video. It was apparent that the majority of the students preferred facilities that involve experimental, applicable, and visual-based materials and devices.

Lastly, when "other option" part is examined, many students who wrote their opinions in this part stated that there must be opportunities to visit museums related with astronomy.

e) Opinions of the elementary students about the significance of the astronomy course

The benefits of the astronomy were asked to the students. The direction was "What kind of benefits could astronomy course provide you? Rank those from the most important one to the least important one giving each a number." The rank of elementary students' opinions about the benefits of the astronomy is given in Table 4.2.11.

Table 4.2.11. Rank of the Elementary Students' Opinions about the Benefits of the Astronomy

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
EART_UNI	2043	1	7	1	7	2.6	2.0	1.52
LOGIC	2040	1	7	1	7	3.2	3.0	1.85
MISCON	2036	1	7	1	7	3.5	3.0	1.58
DAILY_LF	2042	1	7	1	7	3.6	4.0	1.57
DEVICE	2035	1	7	1	7	3.7	4.0	1.79
DIMENSN	2029	1	7	1	7	4.3	5.0	1.45
OTHER	2108	1	7	1	7	5.0	7.0	2.81
Valid N (listwise)	2022							

The items in this part and their abbreviations are as shown below:
Getting information and recognizing the Earth and Universe (EART_UNI)
Logical thinking (LOGIC)
Eliminating misconceptions and misbelieves of people related with astronomy (MISCON)
Getting information related to daily life (DAILY_LF)
Getting information about how to use astronomy devices (binoculars, telescopes etc.) (DEVICE)
Getting information about dimension concepts (size, distance, weight) (DIMENSN)

A large number of students believed that astronomy helped them to get information and to recognize the Earth and Universe. This was the first and major benefit of astronomy according to the students. On the other hand, getting information about dimension concepts (size, distance, and weight) was not given that much importance compared to the other components and regarded as having the least significance.

Moreover, most of the students selected the "other option" and following ideas were obtained about this question. An astronomy course could;

1. Provide interesting things about astronomy

2. Improves the information about astronomy subjects
3. Helps to comprehend the existence of the universe and perfection of it
4. Provides understanding of the Earth and the Earth's place in the universe.

The question tended to get information about the ways the students want to use while sharing and exchanging the knowledge taken from astronomy. The direction was "How would you like to share and exchange the knowledge you gained about astronomy with your friends and other people? Rank those from the most important one to the least important one giving each a number." The rank of the elementary students' opinions about sharing and exchanging the knowledge gained about astronomy with friends and other people is given in Table 4.2.12.

Table 4.2.12. Rank of the Elementary Students' Opinions about Sharing and Exchanging the Knowledge Gained about Astronomy with Friends and Other People

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
WATCH	2055	1	4	1	3	1.6	1.0	0.77
OBSERVE	2057	1	4	1	4	2.2	2.0	0.79
NEWS	2060	1	4	1	4	2.3	2.0	0.69
OTHER	2102	1	4	1	4	3.4	4.0	1.14
Valid N (listwise)	2054							

The items in this part and their abbreviations are as shown below:
By viewing photos and watching films and documentaries about astronomy (WATCH)
By making observations and doing research about astronomy with others (OBSERVE)
By sharing interesting news about astronomy (NEWS)

The best-liked answer was viewing photos and watching films and documentaries about astronomy. Conversely, sharing interesting news about astronomy was the least preferred answer. This showed that students liked visual ways more than audial ones.

The "other opinions" of the students for this question can be listed as follows:

1. Giving information about the astronomy topics to uneducated people
2. Hanging up posters related with the astronomy subjects in the street
3. Making activities about astronomy periodically in the schools
4. Visiting the fairs related with astronomy
5. Forming astronomy discussion groups on the Internet
6. Making discussions about various astronomy subjects in the class
7. Playing games related with astronomy in the schools

Students' opinions about the usefulness of astronomy in improving their interest level towards science and technology was questioned in the DESO. They had two selections "yes" and "no". The question was "Do you believe that your interest will increase in science and technology with the help of astronomy education? Select the appropriate choice and shortly explain your reason." The result of the elementary school students' opinions about the usefulness of astronomy in improving their interest level towards science and technology is given in Table 4.2.13.

Table 4.2.13. The Result of Elementary School Students' Opinions about the Usefulness of Astronomy in Improving their Interest Level towards Science and Technology

		# of Students	%
Attitudes of the elementary schools students on the effects of astronomy on science and technology	Uncertain	50	2.3
	No	138	6.5
	Yes	1945	91.2
	Total	2133	100.0

91.20% of the elementary schools students believed that astronomy affects the interest in science and technology positively.

f) Opinions of the elementary students about the correlation between demographic characteristic of the students and their preference of the content of the astronomy course

When the elementary school students' demographic results are analyzed carefully, interesting results can be presented. First of all, the number of male and female students was approximately equal in the study. The number of the students selected from the elementary schools was mostly 7^{th} grade. Education level of the students' parents was mostly elementary school education. The results of the demographic information of the elementary school students are given in 4.2.14.

Table 4.2.14. The Results of the Demographic Information of the Elementary School Students

		# of Students	%
Gender	Missing	2	0.1
	Male	1096	51.4
	Female	1035	48.5
Class	5th Grade	971	45.5
	7th Grade	1017	47.7
	8th Grade	145	6.8
Mothers' Education Status	Missing	65	3.0
	Illiterate	80	3.8
	Elementary School	1252	58.7
	Middle School	337	15.8
	Secondary School	309	14.5
	College	11	0.5
	University	79	3.7
Fathers' Education Status	Missing	59	2.8
	Illiterate	19	0.9
	Elementary School	799	37.5
	Middle School	524	24.6
	Secondary School	513	24.1
	College	13	0.6
	University	206	9.7
Location of Schools	Keçiören	502	23.5
	Çankaya	421	19.7
	Yenimahalle	337	15.8
	Mamak	305	14.3
	Altındağ	294	13.8
	Sincan	274	12.8

n= 2133

The opinions of the elementary school students were gathered about the preference of the astronomy topics. Results of elementary school students about the preference of the astronomy topics are given in Table 4.2.15.

Table 4.2.15. Results of the Elementary School Students about the Preference of the Astronomy Topics

How astronomy is preferred to be learned?	f	%
Under a Separate Course	1162	54.5
Doesn't Matter	619	29.0
Under an Existing Course	330	15.5
Total	2133	100.0

54.5 % of the elementary school students preferred to learn the astronomy topics under a separate course, 29 % of students thought that astronomy education can be given either under a separate or an existing course, and only 15.5 % of the elementary school students preferred to learn the astronomy topics under an existing course.

Table 4.2.16 was prepared in order to give some relationships between the preference of astronomy and many categorical variables. In the table, there are four columns. The first column includes the variables' names, and the second, the third and the forth columns show the percentages of students who preferred astronomy under a separate course (USC), under an existing course (UEC) such as science or social science courses, and who said it did not matter (DM).

Also in each column there are two more columns, the first one always demonstrate the percentages of the students within the total number of students, and the second one indicates the percentages of the students within the same demographic groups. For example, the percentage of the male students that support the astronomy as the USC is 45.52 in the total number of the students that support the astronomy as the USC. Similarly, the percentage of the male students that support the astronomy as the USC is 49.03 in the total number of male students. The results of the astronomy preference and demographic relation of the elementary school students are given in Table 4.2.16.

Table 4.2.16. The Results of the Astronomy Preference and Demographic Relation of the Elementary School Students

	How astronomy is preferred to be learned?						
	USC%		DM %		UEC %		Number of students
	% within the total number	% within the same demographic group	% within the total number	% within the same demographic group	% within the total number	% within the same demographic group	
Gender							
Male	45.52	49.03	58.16	33.36	57.58	17.61	1079
Female	54.30	60.88	41.84	25.39	42.42	13.73	1020
Not Mentioned	1.03	100.00	-	-	-	-	12
Total Number	1162		619		330		2111
Grade Level							
5th Grade	42.25	50.88	50.89	32.64	48.18	16.48	965
7th Grade	50.60	58.33	43.46	26.69	45.76	14.98	1008
8th Grade	7.14	60.14	5.65	25.36	6.06	14.49	138
Total Number	1162		619		330		2111
Mothers' Education Status							
Illiterate	3.80	53.75	4.34	32.50	3.16	12.50	80
Elementary School (1-5 grades)	58.83	53.19	61.44	29.39	64.87	16.37	1252
Middle School (6-8 grades)	16.35	54.89	15.19	27.00	18.04	16.91	337
Secondary School (9-11grades)	15.99	58.58	15.36	29.77	10.76	11.00	309
College	0.53	54.55	0.33	18.18	0.95	27.27	11
University	4.51	64.56	3.34	25.32	2.22	8.86	79
Total Number	1132		599		316		

Table 4.2.16 (cont'd)

Fathers' Education Status							
Illiterate	0.88	52.63	1.00	31.58	0.63	10.53	19
Elementary School (1-5 grades)	37.16	53.07	41.44	30.91	37.54	14.89	799
Middle School (6-8 grades)	24.45	53.24	26.51	30.15	26.18	15.84	524
Secondary School (9-11grades)	24.42	56.53	23.15	26.90	25.24	15.59	513
College	0.96	86.62	-	-	0.63	15.38	13
University	11.13	61.65	7.89	22.82	9.78	15.05	206
Total Number	1141		596		317		
Locations							
Keçiören	25.30	58.57	19.71	24.30	23.94	15.74	502
Çankaya	20.83	57.48	20.36	29.93	14.24	11.16	421
Yenimahalle	13.60	46.88	22.78	41.84	10.91	10.68	337
Mamak	13.25	50.49	15.67	31.80	15.15	16.39	305
Altındağ	13.43	53.06	11.47	24.15	14.40	21.77	294
Sincan	13.60	57.66	10.02	22.63	16.36	19.71	274
Total Number	1162		619		330		

USC: Under a Separate Course
DM: Doesn't Matter
UEC: Under an Existing Course

When the table is examined carefully, some important results can be gathered. The percentage of the females (54.30%) that want to see the astronomy course under a separate course is significantly greater than the percentage of the males (45.52%). The percentage of the females (42.42%) that want to see the astronomy course under an existing course is less than the percentage of the males (57.58%). This shows that female students compared to the males favor astronomy under a separate course.

Furthermore, when the grade levels increase, the preference of the astronomy under a separate course becomes more favorable (5^{th} grades

50.88%, 7th grades 58.33%, and 8th grades 60.14% within the same demographic group), and this parallelism exists in other preference types, which indicates that the preference of the astronomy course under an existing course becomes less when the grade levels increase (5th grades 16.48%, 7th grades 14.98%, and 8th grades 14.49% within the same demographic group).

When the correlation between parents' education levels and astronomy course preferences are assayed, parents' education levels of the students have significant effect on the preference of the astronomy course as a separate course or under an existing course. There is a slight deviation in the percentages of the students whose mothers and fathers are university graduates. In this education level, the percentages of the students who preferred the astronomy course under a separate course is 64.56 and 61.65, and the percentages of the students who preferred the astronomy education under an existing course is 8.86 and 15.05. The percentages of the students whose fathers are university graduates are significantly different from the other graduate levels. The percentages of the students whose mothers are university graduates have a small number in the sample size, so it can be ignored. The sample of the parents who graduated from college can also be ignored.

For this reason, except for education level that are ignored, it can be easily claimed that as the education level of parents increases, the percentages of students preferring astronomy also increases (53.19% elementary, 54.89% middle school, 58.58% secondary school and 64.56% university graduates of students' mothers; 53.07% elementary, 53.24% middle school, 56.53% secondary school and 61.65% university graduates of students' fathers).

4.3. The Results of the Secondary Schools Students Questionnaire

a) Opinions of the secondary school students about the content of the astronomy course

The most important result was taken from the percentages of the preference of the given astronomy subject in part three in the Q-DSSO (See Appendix P). It was obviously said that more conceptual and great interest topics were chosen by secondary schools students. Also, it was concluded that topics selected by the secondary school students mainly focus on the questions related with attractive and excited subjects. For example, stars and huge celestial bodies (84.5%), space studies (82.4%), form of the Universe and its evolution (77.4%), the motion of the Sun and planets (77.0%), other life forms and other solar systems (74.5%), telescopes, satellites and their usages (73.8%), the relationships of the Sun, the Earth, and the Moon with each other (72.7%), the effects of the Sun on the life on the Earth (71.8%). On the other hand, although the percentages were grater than 50, the motion of the Earth in a day and around the Sun (61.4%), the concept of time and calendars (55.4%), history of astronomy (54.7%), mass gravity force and the effects of it on the objects (54.1%), and light and shadow (44.2%) stayed behind in their preferences. The percentages of the preferred astronomy subjects in secondary schools students' results are given in Table 4.3.1.

Table 4.3.1. The Percentages of the Preferred Astronomy Subjects in Secondary Schools Students' Results

TOPICS		f	%
T.1.Light and shadow (Ex. The behavior of light. Forms of shadow)	M	19	1.6
	N	640	54.2
	Y	521	44.2
T.2.Mass gravity force and the effects of it on the objects (Ex. Gravity force and Tides)	M	19	1.6
	N	523	44.3
	Y	638	54.1
T.3.The motion of the Sun and the planets (Ex. The orbit of the Planets and their features)	M	16	1.4
	N	255	21.6
	Y	909	77.0
T.4.The effects of the Sun on the life on the Earth (Ex. The importance of the Sun as an energy source and its effects on the ecology systems on Earth)	M	21	1.8
	N	312	26.4
	Y	847	71.8

Table 4.3.1 (cont'd)

T.5.The motion of the Earth in a day and around the Sun (Ex. The formulation of day and night. A year and seasons)	M	22	1.9
	N	434	36.8
	Y	724	61.4
T.6.The relationships of the Sun. the Earth and the Moon with each other (Ex. Solar and lunar eclipse)	M	28	2.4
	N	294	24.9
	Y	858	72.7
T.7.History of Astronomy (Ex. Copernic. Kepler. Galileo. Tycho. Newton)	M	19	1.6
	N	516	43.7
	Y	645	54.7
T.8.The concept of time and calendars	M	33	2.8
	N	493	41.8
	Y	654	55.4
T.9.Telescopes. satellites and their usages	M	22	1.9
	N	287	24.3
	Y	871	73.8
T.10.Space studies (Ex. Apollo. Hubble)	M	20	1.7
	N	188	15.9
	Y	972	82.4
T.11.Stars and huge celestial bodies (Ex. Nebulas. Galaxies)	M	19	1.6
	N	164	13.9
	Y	997	84.5
T.12.Form of the universe and its evolution (Ex. The birth of stars and galaxies. Their forms and evolution)	M	24	2.0
	N	243	20.6
	Y	913	77.4
T.13.Other life forms and other solar systems	M	26	2.2
	N	275	23.3
	Y	879	74.5
T.14.Virtual lines in the sky: horoscopes signs	M	20	1.7
	N	339	28.7
	Y	821	69.6

Note: n= 1180

*Missing, **No, ***Yes

These results demonstrated that secondary school students preferred astronomy topics arousing interest and attention rather than boring and abstract ones. Although secondary school students prefer the interesting and attractive astronomy topics rather than incomprehensive and abstract ones, there is a need to increase the interest level of these students in more abstract and necessary subjects such as history of astronomy, light and shadow, and the concept of time and calendars etc.

The fourth part of the Q-DSSO involved an open-ended question which aimed to find out if the students want to learn any other astronomy subjects besides the ones in the third part (See Appendix P). The question was "Are there any other astronomy subjects that you want to learn and which are not mentioned in the previous part (in the third part of the Q-DSSO). If there are, write their names and why they should be included." The additional preference of secondary school students about astronomy topics are listed from the mostly wanted topics to the less wanted topics in Table 4.3.2.

Table 4.3.2. Astronomy Subjects Added by the Secondary School Students

Main Topic	Subtopics
Astronomy	Main goals of astronomy / Effects of astronomy in the future / Mythological aspects of astronomy
Astronauts	Criteria for being an astronaut / Tasks and duties of the astronauts / Education period of astronauts / Interesting experiences of astronauts / Daily life of astronauts in the space (nourishment, basic needs etc.) / Whether there is an astronomy school for this job in Turkey
The Earth	Formulation of the Earth / Theories related with the end of the Earth
Universe	Formulation of the universe / Possible life forms in the universe / Theories related with the existence of the universe / The beginning of the time and the universe / Universe-matter-time relations
Galaxies	Formulation of galaxies / Types of galaxies and their properties / Possibility of traveling to other galaxies
Other Planets	Formulation of the planets / Possibility of life forms in the planets / Conditions needed to live on the other planets / Structure of the planets / Steps of the investigation of the new planets / Motion of the planets in the solar system / Distant planets
The Sun	Effects of the Sun on other planets in the solar system / The amount of the solar energy and the time of its coming to an end

Table 4.3.2 (cont'd)

Mars	More detailed information about Mars
Space	Space ships and their properties / Space ships' technology / Artificial satellites and principle working of them / Areas to use them and benefits of them to the nations / Steps of going to the space / Whether there are any life forms in the space / Whether there is a UFO in the space / Theories about the UFOs / The reason why the gravity force is low in the space
Stars	Formulation of the stars / Way of measuring distance of the stars from the Earth / Comets and their properties
Others	Black holes and their properties / Definition and formulation of the black matters / The concepts of relativistic approach of Einstein / Meteorites and their properties

Challenging astronomy subjects that secondary school students study in their lessons are asked to the students. The question was "What are the astronomy topics, which are taught under Geography and Physics lessons, that you have difficulty in understanding? How should they be taught?" Approximately, 120 secondary school students expressed their opinions related with the subjects they have difficulty. The results of the astronomy topics difficulties are given in Table 4.3.3.

Table 4.3.3. Astronomy Topics' Difficulties of Secondary School Students

Astronomy Topics	≈n
1. Concepts of the time and calendars	5
2. Gravity force	10
3. Light and Shadows	5
4. Milk way and its properties	5

Table 4.3.3 (cont'd)

5. Solar and Lunar eclipse	5
6. Solar system	5
7. Sound and light	5
8. Space	5
9. Structure of the Universe and its evolution	5
10. The formulation of the day and night	5
11. The formulation of the seasons	5
12. The movement of the planets in the solar system	5
13. Climate of the Earth	5
14. Motion of the Earth, concept of meridians and parallels	5
15. Kepler laws	25
16. Mass and gravity	5
17. Mathematical position of the Earth	5
18. Geological phase of the Earth	5
19. Calculation of time difference	5

b) Opinions of the secondary school students about the teaching and learning methods in the astronomy course

The students' opinions for an astronomy course to learn the subjects better are questioned. The direction was "Imagine that there is an astronomy course in your school; which one would be more necessary to you to learn the subjects better? Rank those from the most important one to the least important one giving each a number." The rank of secondary school students' opinions about an astronomy course to learn the subjects better is given in Table 4.3.4.

Table 4.3.4. Rank of the Secondary School Students' Opinions about an Astronomy Course to Learn the Subjects Better

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean*	Median	Std. Dev.
DAILY	1130	1	8	1	8	2.8	2.0	1.83
CLEAR	1131	1	8	1	7	3.2	3.0	1.55
WITH_EXP	1130	1	8	1	8	3.3	3.0	1.77
SIMPLE_F	1126	1	8	1	8	4.2	4.0	1.91
IN_RELAT	1126	1	8	1	8	4.7	5.0	1.84
PRE_KNOW	1126	1	8	1	8	4.8	5.0	1.94
TIME	1127	1	8	1	8	5.2	6.0	1.86
OTHER	1144	1	8	1	8	4.9	5.0	3.18
Valid N (listwise)	1121							

* The small mean demonstrate the most favorable item, oppositely large mean demonstrate the least favorable item.

The items in this sub-part and their abbreviations are as shown below:

Making connections with daily life experiences (DAILY)
With clear instructions and information (CLEAR)
With simple and clear experiments (WITH_EXP)
With simple formulations (SIMPLE_F)
Presenting the subjects in relation with each other (IN_RELAT)
Eliminating the lack of pre-knowledge and misconceptions (PRE_KNOW)
Presenting the subjects in a sufficient period of time (TIME)

The majority of the students regarded making connections with daily life experiences as the most important component to learn the astronomy subjects better. On the other hand, presenting the subjects in a sufficient period of time was not given that much importance compared to the other selections and regarded as having the least importance.

Some secondary school students wanted to see additional situations to learn the astronomy subjects better. These can be listed by the following way:

1. The qualified instructors must teach the astronomy topics
2. There must be funny and amusing activities
3. There must be no memorization in the astronomy course
4. The course must have attractive and interesting activities
5. There must be visual materials and technologies in the course

Students' opinions about teaching and learning methods were asked in the Q-DSSO and the direction was "With which teaching and learning methods would you like to learn astronomy subjects? Rank those from the most important one to the least important one giving each a number." The rank of secondary school students' opinions about teaching and learning methods is given in Table 4.3.5.

Table 4.3.5. Rank of the Secondary School Students' Opinions about Teaching and Learning Methods

	N	Pos. Min.	Pos. Max	Min.	Max.	Mean	Median	Std. Dev.
EXPERMNT	1117	1	9	1	8	2.7	2.0	1.94
DISCUSS	1115	1	9	1	8	3.8	3.0	1.82
PROJECT	1108	1	9	1	8	4.1	4.0	1.96
COMPUTER	1113	1	9	1	9	4.3	4.0	2.27
INTEREST	1110	1	9	1	8	4.3	5.0	2.10
GROUP	1107	1	9	1	8	4.7	5.0	1.69
GAMES	1101	1	9	1	8	5.1	5.0	2.09
TEACHER	1083	1	9	1	9	6.9	8.0	1.98
OTHER	1172	1	9	1	8	2.5	1.0	1.64
Valid N (listwise)	1077							

The items in this part and their abbreviations are as shown below:

With experiments and observations (EXPERMNT)
Within a discussion and research environment (DISCUSS)
With preparing projects (PROJECT)
With computer – based techniques (COMPUTER)
With the activities designed according to interest and knowledge level (INTEREST)
With group work activities (GROUP)
With class games (GAMES)
With teacher – centered methods (TEACHER)

The majority of the students taught that experiments and observations were most important methods to teach and learn the subjects better. The reasons of the students were classified as the following way:

- Keeping the information in mind easily
- Allowing better understanding of the theoretical information
- Allowing to store the information in long term memory
- Causing better understanding of the information
- Developing the psychomotor domain
- Helping to reach the main goals with more understandable, simple and fast ways.

Conversely, the teacher – centered methods was not given that much importance compared to the other components of the part and believed to have the least significance. The students supported why they gave the least importance to the teacher – centered methods with the following sentences:

1. This method is incomprehensible
2. Teacher – centered method is not enough to teach the subjects
3. I do not understand with the teacher – centered method
4. We can join the lecture and participate in the lecture if different types of teaching methods are used by the instructors
5. Teacher – centered method is boring and unwell.
6. The information is stored in mind for a short time with this method.

The opinions of the secondary schools students about the ways to be followed when teaching the astronomy topics are given in Table 4.3.6.

Table 4.3.6. Opinions of the Secondary School Students about the Ways to be Followed when Teaching the Astronomy Topics

Ways to Learn the Astronomy Topics Better	≈n
1. Giving clear and comprehensible explanations	25
2. Education conditions including necessary devices and materials related with astronomy topics	25
3. Amusing class environment and topics arousing interest and attraction of the students	25
4. Learning the astronomy subject with the qualified and expert teachers	10
5. Learning the astronomy subjects in more detailed way, not with superficial and simple teaching methods	25
6. Considering appropriate grade levels	5
7. Using simple, easy and understandable methods	25
8. Explaining the astronomy topics with the help of experiments, observations, games, projects, and models	50
9. Teaching the astronomy topics by using computers, OHPs, films, slides, and photographs	50
10. Class environment allowing discussions and cooperation between the teacher and students	10
11. Class environment that allows to do research and investigation for students	5
12. Class environment that includes visual materials like TV and videos	5
13. Using daily life experiences related with the astronomy topics	10

Table 4.3.6 (cont'd)

14. Giving lots of attractive, interesting, and intriguing examples that can arouse curiosity	25
15. Well-done classroom management	10
16. Declining many formulations	10
17. Providing concrete explanations of the topics and avoiding memorization	10
18. Teaching topics in small class size	10
19. Giving enough time to the topics	20
20. Eliminating lack of the pre-knowledge and misconceptions	25

c) Opinions of the secondary school students about the evaluation process in the astronomy course

The students' opinions were aimed to be gathered about the evaluation of astronomy. The direction was "Which of them below would you like to see in the evaluation process of the astronomy course? Rank those from the most important one to the least important one giving each a number." The rank of secondary school students' opinions about evaluation process is given in Table 4.3.7.

Table 4.3.7. Rank of the Secondary School Students' Opinions about Evaluation Process

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
SKILLS	1124	1	6	1	5	2.2	2.0	1.17
PROJECTS	1120	1	6	1	6	2.6	3.0	1.20
CLASSWRK	1123	1	6	1	6	2.7	3.0	1.28
GRUP_OBS	1120	1	6	1	6	3.2	3.0	1.19
W_OR_EX	1119	1	6	1	6	4.3	5.0	1.21
OTHER	1160	1	6	1	6	3.1	1.5	2.26
Valid N (listwise)	1112							

The items in this part and their abbreviations are as shown below:

According to the skills of performance, observations and experiments (SKILLS)
According to the results of projects work (PROJECTS)
According to the class work observation (CLASSWRK)
According to the group work studies (GRUP_OBS)
According to the written and oral exams (W_OR_EX)

A great number of students preferred to be evaluated with an evaluation process that includes the skills of performance, observations and experiments. Furthermore, the majority of them supported performance based evaluation process. In contrast, the written and oral exams were preferred the least, which indicates that the majority of the students do not favor these evaluation types.

Most students said in the "other option" that evaluation must be done according to:

1. The interpretation and discussion abilities
2. Students' participation and attention to class activities
3. The conviction of the instructors

Moreover, a few students (n>10) are object to take any grades in this course.

d) Opinions of the secondary school students about the learning environment and facilities in the astronomy course

The question was asked to learn the students' preference about the teaching – learning environment that they believed created better education environment. The direction was "In what kind of a teaching – learning environment would you prefer to learn the astronomy subjects? Rank those from the most important one to the least important one giving each a number."

The rank of the secondary school students' opinions about the teaching – learning environment is given in Table 4.3.8.

Table 4.3.8. Rank of the Secondary School Students' Opinions about the Teaching – Learning Environment

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
COORP	1129	1	5	1	5	1.8	2.0	0.94
GROUP_W	1125	1	5	1	5	2.1	2.0	0.97
TEACHR_B	1117	1	5	1	5	3.0	3.0	0.94
INDIVID	1122	1	5	1	5	3.1	3.0	1.02
OTHER	1152	1	5	1	5	2.1	1.0	1.64
Valid N (listwise)	1115							

The items in this part and their abbreviations are as shown below:

In an environment where there is a cooperation between the teacher and the student (COORP)
In an environment where group work activities take place (GROUP_W)
In an environment where teacher transfer the knowledge (TEACHR_B)
In an environment where individual work is basically done (INDIVID)

Greater part of the students regarded the environment where there is cooperation between the teacher and the students as the most important aspect of a teaching and learning environment to learn the astronomy subjects better. Moreover, group-work activities and transferring the knowledge by the teacher were other preferences of the students. It was obvious that students favored the cooperation approaches rather than the individual ones. That is why the most of the students considered the environment where individual work is basically done was the least important aspect.

Many secondary school students advised additional cases for the teaching and learning environment by writing their ideas in the "other opinion" part. These suggestions included following advices: an environment;

1. Where students have an opportunity to make experiments
2. Where observations and investigations are done related with the astronomy subjects
3. Where there are adequate equipments and devices about astronomy
4. Where the visual devices and high technological conditions are present

The question was asked to learn the students' opinions about useful facilities for an astronomy course. The direction was "What kind of facilities should be provided for the astronomy course? Rank those from the most important one to the least important one giving each a number." The rank of secondary school students' opinions about facilities that provided for astronomy course is given in Table 4.3.9.

Table 4.3.9. Rank of the Secondary School Students' Opinions about Facilities that Provided for Astronomy Course

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
LAB	1117	1	8	1	7	2.9	3.0	1.76
TV	1117	1	8	1	7	3.0	3.0	1.93
OHP	1114	1	8	1	8	3.6	3.0	1.87
LIBRARY	1112	1	8	1	8	4.2	4.0	1.79
JOURNAL	1118	1	8	1	8	4.7	5.0	1.82
STORY	1111	1	8	1	8	4.8	5.0	1.91
DIALOG	1113	1	8	1	8	4.8	5.0	1.89
OTHER	1167	1	8	1	8	2.8	1.0	3.03
Valid N (listwise)	1104							

The items in this part and their abbreviations are as shown below:

Facilities that include laboratories where there are materials and models related with astronomy subjects (LAB)
Facilities that include devices like TV and videos (TV)
Facilities that include OHP and slides (OHP)
Facilities that provide doing research on astronomy (LIBRARY)
Facilities that include having a membership of a journal or a book related with astronomy (JOURNAL)
Facilities that include activities prepared with stories and scenarios that can be performed in class (STORY)
Facilities that provide a discussion environment where students can speak out their ideas related with astronomy (DIALOG)

Most of the students selected facilities that include laboratories where there are materials and models related with the subjects as the fist preference to learn the subject matters better. However, it had a great standard deviation which reflected that the selection scale of this item was either the first or last choice. In addition, they considered that TVs, videos, OHPs and slides were crucial facilities coming after the laboratories where there are materials and models. There was no doubt that the majority of the students preferred facilities that involve experimental, applicable, and the visual materials and devices.

Some secondary school students suggested in the “other option part” that suggestions can be classified with following ways:

1. Students must visit observatories, science centers and museums related with the astronomy subjects
2. There must be astronomy camps in order to make an experiments and observations related to astronomy
3. There must be periodical activities in the schools related with the astronomy topics

e) Opinions of the secondary school students about the significance of the astronomy course

The benefits of the astronomy were asked to the students in the Q-DSSO. The direction was "What kind of benefits could astronomy course provide you? Rank those from the most important one to the least important one giving each a number." The rank of secondary school students' opinions about the benefits of the astronomy is given in Table 4.3.10.

Table 4.3.10. Rank of the Secondary School Students' Opinions about the Benefits of the Astronomy

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
EART_UNI	1124	1	7	1	6	2.1	2.0	1.35
DAILY_LF	1117	1	7	1	6	3.4	3.0	1.57
MISCON	1118	1	7	1	7	3.4	3.0	1.62
LOGIC	1121	1	7	1	6	3.7	4.0	1.66
DIMENSN	1121	1	7	1	6	4.0	4.0	1.49
DEVICE	1118	1	7	1	7	4.3	5.0	1.65
OTHER	1171	1	7	1	7	5.1	7.0	3.1
Valid N (listwise)	1110							

The items in this part and their abbreviations are as shown below:

Getting information and recognizing the Earth and the universe (EART_UNI)
Getting information related to daily life (DAILY_LF)
Eliminating misconceptions and misbelieves of people related to astronomy (MISCON)
Logical thinking (LOGIC)

Getting information about dimension concepts (size. Distance. Weight) (DIMENSN)
Getting information about how to use astronomy devices (binoculars, telescopes etc.) (DEVICE)

A large number of students believed that astronomy was beneficial for getting information and recognizing the Earth and the Universe. This was the initial benefit of astronomy according to the students. On the other hand, getting information about how to use astronomy devices (binoculars. Telescopes etc.) was not given that much importance compared to the other components and regarded as having the least importance.

The question was asked to the students in order to get information about the ways of sharing and exchanging the knowledge collected from astronomy subjects. The direction was "How would you share and exchange the knowledge you gained about astronomy with your friends and other people? Rank those from the most important one to the least important one giving each a number." The rank of the secondary school students' opinions about sharing and exchanging the knowledge gained about astronomy with friends and other people is given in Table 4.3.11.

Table 4.3.11. Rank of the Secondary School Students' Opinions about Sharing and Exchanging the Knowledge Gained about Astronomy with Friends and Other People

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
WATCH	1126	1	4	1	3	1.7	1.0	0.78
OBSERVE	1126	1	4	1	3	2.0	2.0	0.78
NEWS	1125	1	4	1	4	2.3	2.0	0.76
OTHER	1168	1	4	1	4	2.6	3.0	1.51
Valid N (listwise)	1125							

The items in this part and their abbreviations are as shown below:

By viewing photos and watching films and documentaries about astronomy (WATCH)

By making observations and doing research about astronomy with others (OBSERVE)

By sharing interesting news about astronomy (NEWS)

The most favorable answer of the students included viewing photos and watching films and documentaries about astronomy so as to share and exchange the qualified knowledge gained about astronomy. Conversely, sharing interesting news about astronomy was thought to be the least important. This result was also similar with the primary school students' choices.

Many secondary school students expected to share the information about astronomy subjects with their friends in different ways:

1. Discussing the astronomy topics with their friends in class
2. Preparing games and funny scenario about the astronomy
3. Preparing web pages in order to distribute the knowledge about the astronomy with other people

The usefulness of astronomy in improving the students' interest level towards science and technology was questioned. Students had two selections: "yes" and "no". The question was "Do you believe that your interest will increase in science and technology with the help of astronomy education? Select the appropriate choice and shortly explain your reason." The result of secondary school students' opinions about the usefulness of astronomy in improving their interest level towards science and technology is given in Table 4.3.12.

Table 4.3.12. The Result of Secondary School Students' Opinions about the Usefulness of Astronomy in Improving their Interest Level towards Science and Technology

		# of Students	%
Attitudes of the secondary schools students on the effects of astronomy on science and technology	Uncertain	52	4.4
	No	97	8.2
	Yes	1031	87.4
	Total	1180	100.0

87.40% of the secondary schools students, similar to elementary school students, believed that astronomy affects the science and technology positively.

f) Opinions of the secondary students about the correlation between demographic characteristic of the students and their preference of the content of the astronomy course

When the secondary school results are analyzed with awareness, remarkable results can be specified. The number of female students was slightly greater than the number of males. The ratio of the regular secondary school students (46.2%) was greater in size than both Anatolian High school students and students who attend to secondary schools with one year English preparation classes. Education level of the students' mothers was mostly elementary school education (38.1%) and the students' fathers were mostly graduated from the universities (35.3%). The results of the demographic information of the secondary school students are given in Table 4.3.13.

Table 4.3.13. The Results of the Demographic Information of the Secondary School Students

		# of Students	%
Gender	Missing	12	1.0
	Male	528	44.7
	Female	640	54.2
School Types	Regular Secondary School	545	46.2
	Anatolian High School	413	35.0
	Secondary Schools with One Year Preparation Class	222	18.8
Mothers' Education Status	Missing	61	5.2
	Illiterate	12	1.0
	Elementary School	449	38.1
	Middle School	101	8.6
	Secondary School	279	23.6
	College	28	2.4
	University	250	21.2
Fathers' Education Status	Missing	36	3.1
	Illiterate	-	-
	Elementary School	248	21.0
	Middle School	137	11.6
	Secondary School	299	25.3
	College	43	3.6
	University	417	35.3
Location of Schools	Çankaya	373	31.6
	Yenimahalle	276	23.4
	Keçiören	187	15.8
	Mamak	152	12.9
	Altındağ	104	8.8
	Sincan	88	7.5

n= 1180

The opinions of the secondary school students were gathered about the preference of the astronomy topics. Results of secondary school students about the preference of the astronomy topics are given in Table 4.3.14.

Table 4.3.14. Results of the Secondary School Students about the Preference of the Astronomy Topics

How astronomy is preferred to be learned?	f	%
Under a Separate Course	842	71.4
Doesn't Matter	198	16.8
Under an Existing Course	123	10.4
Total	1180	100.0

71.4 % of the secondary school students preferred to learn the astronomy topics under a separate course, 16.8 % of students thought that astronomy topics can be given either under a separate or an existing course, and only 10.4 % of the secondary school students preferred to learn the astronomy topics under an existing course.

Table 4.3.15 was prepared in order to give some relationships between the preference of astronomy and many categorical variables. The purpose of the table was similar with the table that was prepared for elementary schools students. The results of the astronomy preference and demographic relation of the secondary school students are given in Table 4.3.15.

Table 4.3.15. The Results of the Astronomy Preference and Demographic Relation of the Secondary School Students

	How astronomy is preferred to be learned?						
	USC%		DM %		UEC %		Number of students
	% within the total number	% within the same demographic group	% within the total number	% within the same demographic group	% within the total number	% within the same demographic group	
Gender							
Male	43.11	69.54	51.52	19.54	46.34	10.92	522
Female	56.29	74.88	46.97	14.69	53.66	10.43	633
Not Mentioned	0.06	62.50	1.5	37.50	-	-	8
Total Number	842		198		123		1163

Table 4.3.15 (cont'd)

School Types							
Regular Secondary School	46.91	73.83	45.45	16.82	40.65	9.35	535
Anatolian High School	33.14	68.22	41.41	20.05	39.02	11.74	409
Secondary School with One Year Eng. Prep. Class	19.95	76.71	13.13	11.87	20.33	11.42	219
Total Number	842		198		123		
Mothers' Education Status							
Illiterate	1.25	83.33	1.05	16.67	-	-	12
Elementary School (1-5 grades)	41.23	73.27	39.47	16.70	34.45	9.13	449
Middle School (6-8 grades)	9.02	71.29	8.42	15.84	9.24	10.89	101
Secondary School (9-11grades)	24.44	69.89	26.32	17.92	24.37	10.39	279
College	2.63	75.00	1.05	7.14	4.20	17.86	28
University	21.56	68.40	23.68	18.00	27.73	13.20	250
Total Number	798		190		119		
Fathers' Education Status							
Illiterate	-	-	-	-	-	-	-
Elementary School (1-5 grades)	22.17	73.39	20.94	16.13	19.33	9.27	248
Middle School (6-8 grades)	12.91	77.37	9.42	13.14	9.24	8.03	137
Secondary School (9-11grades)	20.07	71.57	28.27	18.06	23.53	9.36	299
College	3.29	62.79	5.24	23.26	4.20	11.63	43
University	35.57	70.02	36.13	16.55	43.70	12.47	417

Table 4.3.15 (cont'd)

Total Number	821		191		119		
Locations							
Çankaya	30.52	68.90	37.88	20.11	28.46	9.38	373
Yenimahalle	21.38	65.22	26.26	18.84	33.33	14.86	276
Keçiören	16.63	74.87	10.61	11.23	17.89	11.76	187
Mamak	12.83	71.05	14.14	18.42	12.20	9.88	152
Altındağ	9.03	73.08	8.10	15.38	8.13	9.62	104
Sincan	9.62	92.05	3.03	6.82	-	-	88
Total Number	842		198		123		

USC: Under a Separate Course
DM: Doesn't Matter
UEC: Under an Existing Course

The table allows interpreting some specific results when it is examined carefully. The percentage of the females (56.29%) that want to see the astronomy course under a separate course is significantly greater than the percentage of the males (43.11%), also the percentage of the females (53.66%) that want to see the astronomy course under an existing course is greater than the percentage of the males (46.34%). This shows that female students compared to the male ones favor astronomy under a separate course more. Furthermore, when the school types are concerned, the preference of the astronomy under a separate course becomes more favorable for secondary schools with one year preparation class (76.71% within the same demographic group) rather than the regular (73.83% within the same demographic group) and Anatolian High schools (68.22% within the same demographic group), and this parallelism exists in other preference types, which indicates the preference of the astronomy course under an existing course.

When the correlation between parents' education levels and astronomy course preferences are analyzed, parents' education levels of the students slightly differ for the preferences of the astronomy course. Students whose mothers graduated from elementary (73.27%) and middle schools (71.29%) favor the astronomy course under a separate course. However, students whose mothers graduated from secondary school (69.89%) and university (68.40%)

do not prefer the astronomy course under a separate course compared to the students whose mothers are elementary and middle school graduates. Finally, it can be claimed that when the students' mother education status increase, the percentages of preference of the astronomy course under a separate course decreases. Education levels consisting of illiteracy and college have a small number in the sample size and they can be ignored.

Father education level of the students who prefer the astronomy course under a separate course was mostly middle school (77.37%) and other education levels' percentages were 73.39% for elementary school graduates, 71.57% for secondary school graduates, and 68.40% for university graduates. In this case, except the college schools education level, when the students' fathers' education status increase, the percentages of preference of the astronomy course under a separate course decreases. The sample of the students' fathers who graduated from college can also be ignored.

4.4. The Results of the Teacher Questionnaire

a) Opinions of the teachers about the content of the astronomy course

The first part of the content analysis of the astronomy course started with collecting the data about the necessity of the astronomy subjects according to the teachers (See Appendix M). When the necessity of the astronomy subjects was analyzed, some abbreviations were used as shown below:

[0] Unnecessary Subject
[1] Not Much Necessary Subject
[2] Neither Necessary nor Unnecessary Subject
[3] Necessary Subject
[4] Much Necessary Subject

The necessity scale of the astronomy subjects was analyzed by the researcher and the results are given in Table 4.4.1.

Table 4.4.1. Necessity Scale of Astronomy Subjects According to the Teachers

Subjects	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
Light and shadow	35	0	4	0	4	2.9	3.0	0.96
Mass gravity force and the effects of it on the objects	35	0	4	1	4	3.1	3.0	0.82
The motion of the Sun and the planets	35	0	4	1	4	3.3	3.0	0.70
The role of gravity force in the solar system	35	0	4	0	4	3.2	3.0	0.99
The effects of the Sun on the life on the Earth	35	0	4	1	4	3.6	4.0	0.65
The motion of the Earth in a day and around the Sun	34	0	4	1	4	3.4	4.0	0.75
Axis inclination of the Earth and its results	34	0	4	0	4	3.1	3.0	1.01
The relationships of the Sun, the Earth and the Moon with each other	34	0	4	0	4	3.3	3.0	0.93
Relativity	33	0	4	0	4	2.8	4.0	1.07
History of Astronomy	34	0	4	0	4	2.7	3.0	1.04
The concept of time and calendars	33	0	4	1	4	3.4	3.0	0.78
Telescopes, satellites and their usages	33	0	4	0	4	2.9	3.0	0.99
Space studies	32	0	4	0	4	3.2	3.0	0.96
Stars and huge celestial bodies	33	0	4	1	4	2.9	3.0	0.88
Form of universe and its evolution	32	0	4	1	4	3.1	3.0	0.83
Expansion of the Universe and its fade	32	0	4	0	4	2.9	3.0	1.01
Other life forms and other solar systems	32	0	4	0	4	2.8	3.0	1.13
Virtual lines in the sky: horoscopes signs*	32	0	4	0	4	2.1	2.0	1.20
Valid N (list wise)	28	0	4					

*This subject does not belong to an area astronomy deals with

Teachers thought that “the effects of the Sun on the life on Earth” (the mean of this subject was 3.6) and “the motion of the Earth in a day and around the Sun” (the mean of this subject was 3.4) were much more necessary subjects that must be included in the course. The least popular topic was “virtual lines

in the sky: horoscopes signs" (the mean of this subject was 2.1). "Virtual lines in the sky: horoscopes signs" was used as a distracter in the given subjects and there is no place of this subject in the astronomy, however, the most of teachers thought that it was neither necessary nor unnecessary subject to the astronomy program.

When the appropriate grade levels for the astronomy subjects that the teachers selected were considered, the expected results were gathered from the teachers. The grade levels classified into four part and simple codes were given to each grade levels. These were [1] From Kindergarten to 3rd grade, [2] From 4th to 5th grades, [3] From 6th to 8th grades, and [4] From 9th to 11th grades. The results of the teachers' opinions about the appropriate grade levels for the astronomy subjects are given in Table 4.4.2.

Table 4.4.2. The Results of the Teachers' Opinions about the Appropriate Grade Level for Astronomy Subjects

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
Light and shadow	35	1	4	1	4	2.6	3.0	1.04
Mass gravity force and the effects of it on the objects	36	1	4	1	4	3.1	3.0	0.97
The motion of the Sun and the Planets	35	1	4	1	4	2.8	3.0	1.07
The role of gravity force in the solar system	35	1	4	1	4	3.3	4.0	0.87
The effects of the Sun on the life on the Earth	36	1	4	1	4	2.5	2.0	0.94
The motion of the Earth in a day and around the Sun	35	1	4	1	4	2.4	2.0	0.94
Axis inclination of the Earth and its results	35	1	4	1	4	2.9	3.0	0.98
The relationships of the Sun, the Earth and the Moon with each other	36	1	4	1	4	2.4	2.0	0.91
Relativity	35	1	4	1	4	3.4	4.0	0.98
History of Astronomy	34	1	4	1	4	3.5	4.0	0.79

Table 4.4.2 (cont'd)

The concept of time and calendars	35	1	4	1	4	2.3	2.0	0.99
Telescopes, satellites and their usages	34	1	4	1	4	3.1	3.0	0.87
Space studies	34	1	4	1	4	3.2	3.0	0.91
Stars and huge celestial bodies	33	1	4	1	4	3.3	3.0	0.84
Form of universe and its evolution	34	1	4	1	4	3.3	3.5	0.84
Expansion of the Universe and its fade	30	1	4	1	4	3.5	4.0	0.86
Other life forms and other solar systems	32	1	4	1	4	3.6	4.0	0.751
Virtual lines in the sky: horoscopes signs*	28	1	4	1	4	3.3	4.0	0.905
Valid N (list wise)	23							

*This subject does not belong to an area astronomy deals with

The opinions of the teachers about the appropriate grade levels for the astronomy subjects are classified in Table 4.4.3.

Table 4.4.3. The Opinions of the Teachers about the Appropriate Grade Levels for the Astronomy Subjects

Grade Level	Astronomy Topics (Mean)
Grades between 4^{th} and 5^{th}	The concept of time and calendars (2.3)
	The relationships of the Sun, the Earth and the Moon with each other (2.4)
	The motion of the Earth in a day and around the Sun (2.4)
	The effects of the Sun on the life on the Earth (2.5)

Table 4.4.3 (cont'd)

Grades between 6th and 8th	Light and shadow (2.6)
	The motion of the Sun and the planets (2.8)
	Axis inclination of the Earth and its results (2.9)
	Telescopes, satellites and their usages (3.1)
	Mass gravity force and the effects of it on the objects (3.1)
Grades between 9th and 11th	Space studies (3.2)
	Stars and huge celestial bodies (3.3)
	The role of gravity force in the solar system (3.3)
	Form of the universe and its evolution (3.3)
	Relativity (3.4)
	Expansion of the universe and its fate (3.5)
	History of the astronomy (3.5)
	Other life forms and other solar systems (3.6)

Teachers' ideas about the type of information related to astronomy subjects they want to give in their lessons were asked and the direction was "What would you like to teach in the astronomy course? Rank those from the most important one to the least important one giving each a number." The rank of the teachers' opinions about the teaching – learning environment is given in Table 4.4.4.

Table 4.4.4. Rank of Teachers' Opinions about the Teaching - Learning Environment

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
DAILY_LF	21	1	5	1	4	1.8	1.0	1.04
DAILY_SB	21	1	5	1	4	2.1	2.0	0.91
PROJCT_W	21	1	5	1	4	2.5	3.0	0.98
AST_HIST	21	1	5	2	4	3.6	4.0	0.68
Valid N (list wise)	21							

The items in this sub-part and their abbreviations are as shown below:

Astronomy subjects related with the daily life facts (DAILY_LF)
Subjects related with current development of astronomy (DAILY_SB)
Projects working related with the astronomy (PROJCT_W)
History of Astronomy (AST_HIST)

The most favorable answer to this question was teaching astronomy subjects related with the daily life facts so as to instruct the subjects in the astronomy course better. However, teaching history of astronomy was the least important item according to the teachers.

b) Opinions of the teacher about the teaching and learning methods in the astronomy course

The teachers' opinions for an astronomy course to teach the subjects better were inquired. The direction was "What kinds of precautions would you take to overcome learning difficulties and misconceptions of the students in an astronomy course? Rank those from the most important one to the least important one giving each a number." The rank of teachers' opinions about teaching the subjects better in an astronomy course is given in Table 4.4.5.

Table 4.4.5. Rank of the Teachers' Opinions about an Astronomy Course to Teach the Subjects Better

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
DAILY	20	1	8	1	5	2.6	2.0	1.54
CLEAR	20	1	8	1	5	2.8	3.0	1.40
EXPERMNT	20	1	8	1	6	3.8	4.0	1.44
IN_RELAT	20	1	8	1	7	3.9	3.0	1.90
PRE_KNOW	20	1	8	1	7	4.3	5.0	2.38
SMPL_F	20	1	8	2	7	5.0	5.5	1.38
TIME	20	1	8	1	7	5.7	7.0	2.03
Valid N (list wise)	20							

The items in this part and their abbreviations are as shown below:

Making connections with daily life experiences (DAILY)
With clear instructions and information (CLEAR)
With simple and clear experiments (EXPERMNT)
Presenting the subjects in relation with each other (IN_RELAT)
Eliminating the lack of pre-knowledge and misconceptions (PRE_KNOW)
With simple formulations (SMPL_F)
Presenting the subjects in a sufficient period of time (TIME)

Most of the teachers regarded making connections with daily life experiences as the most important component to teach the astronomy subjects better. On the other hand, presenting the subjects in a sufficient period of time was not given that much importance compared to the other components and regarded as having the least importance.

Teachers' opinions about teaching and learning methods were asked in the Q-DSO and the direction was "With which teaching and learning methods would you like to teach the astronomy subjects? Rank those from the most

important one to the least important one giving each a number." The rank of teachers' opinions about teaching and learning methods is given in Table 4.4.6.

Table 4.4.6. Rank of the Teachers' Opinions about Teaching and Learning Methods

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
EXPERI	20	1	9	1	7	2.6	2.0	1.88
DISCUSS	20	1	9	2	6	3.6	3.0	1.50
INTEREST	20	1	9	1	8	4.2	4.0	2.32
COMPUTER	20	1	9	1	8	4.3	4.5	2.43
PROJECT	20	1	9	1	8	4.5	4.0	2.11
GAMES	20	1	9	1	7	4.6	5.0	1.79
GROUP	20	1	9	1	8	4.8	5.0	1.86
TEACHER	21	1	9	1	8	7.4	8.0	1.53
Valid N (list wise)	20							

The items in this part and their abbreviations are as shown below:

With experiments and observations (EXPERI)
Within a discussion and research environment (DISCUSS)
With activities designed according to interest and knowledge level (INTEREST)
With computer – based techniques (COMPUTER)
With projects (PROJECT)
With class games (GAMES)
With group work activities (GROUP)
With teacher – centered methods (TEACHER)

The majority of the teachers taught that experiments and observations were the most important methods to teach and learn the subjects better.

Conversely, the teacher – centered methods were not regarded that much important compared to the others and believed to be the least beneficial way of teaching.

c) Opinions of the teachers about the evaluation process in the astronomy course

The teachers' opinions were gathered about the evaluation process of an astronomy course. The direction was "Which of them below would you like to see in the evaluation process of an astronomy course? Rank those from the most important one to the least important one giving each a number." The rank of teachers' opinions about evaluation process is given in Table 4.4.7.

Table 4.4.7. Rank of the Teachers' Expectations about Evaluation Process

	N	Pos. Min.	Pos. Max.	Min.	Max.	Mean	Median	Std. Dev.
SKILLS	20	1	6	1	4	1.8	1.5	0.91
PROJECTS	20	1	6	1	5	2.2	2.0	1.18
CLASS_WK	20	1	6	1	5	3.3	3.0	1.09
GROUP_W	20	1	6	1	5	3.3	3.0	1.13
W_OR_EX	20	1	6	3	5	4.7	5.0	0.67
Valid N (list wise)	20							

The items in this part and their abbreviations are as shown below:

According to the skills of performance, observations and experiments (SKILLS)
According to the results of projects work (PROJECTS)
According to the class work observation (CLASS_WK)
According to the group work studies (GROUP_W)
According to the written and oral exams (W_OR_EX)

A great number of teachers preferred to evaluate students with an evaluation process that includes the performance skills, the observations and experiments. Furthermore, the majority of them supported performance based evaluation process. In contrast, the written and oral exams were preferred the least, which indicates that the majority of the teachers do not favor these evaluation types.

d) Opinions of the teachers about the significance of the astronomy course

51.4% of the teachers believed that the astronomy subjects must be taught under an existing course for the grade levels between kindergarten and 3rd, and 43.2% of the teachers thought that astronomy subjects must be given under an existing course for the grade levels between 4th and 5th. Conversely, for the grade levels between 6th and 8th and for the grade levels between 9th and 11th, the astronomy subjects were thought to be taught under a separate course by the teachers and percentages were 56.8 and 70.3, respectively. The results of the opinions of the teachers about the appropriate grade level to the astronomy education are given in Table 4.4.8.

Table 4.4.8. Opinions of the Teachers about the Appropriate Grade Level to the Astronomy Education

Grade Level		# of Teacher	%
From Kindergarten to 3rd	Missing number	12	32.4
	Under a separate Course	5	13.5
	Doesn't Matter	1	2.7
	Under an Existing Course	19	51.4
From 4th to 5th	Missing number	9	24.3
	Under a separate Course	12	32.4
	Doesn't Matter	-	-
	Under an Existing Course	16	43.2

Table 4.4.8 (cont'd)

From 6^{th} to 8^{th}	Missing number	9	24.3
	Under a separate Course	21	56.8
	Doesn't Matter	-	-
	Under an Existing Course	7	18.9
From 9^{th} to 11^{th}	Missing number	9	24.3
	Under a separate Course	26	70.3
	Doesn't Matter	-	-
	Under an Existing Course	2	5.4

The open ended questions were not answered by the teachers, therefore, the opinions of the teachers about the learning environment and facilities in the astronomy course and the significance of the astronomy course were not collected by the researcher.

CHAPTER 5

CONCLUSIONS, IMPLICATION AND RECOMMENDATIONS

The purposes of this study include to examine the general characteristics of international astronomy programs and to define the similarities and differences between these programs and the astronomy subjects in our national science program; to collect the opinions of the elementary and secondary schools' students and teachers about the content, the teaching and learning methods, the evaluation process, the learning environment and facilities, and the significance of the astronomy course in order to develop an astronomy program for Turkish elementary and secondary schools in the context of the needs analysis; to analyze the relationships between the demographic features of elementary and secondary schools students and their preference of astronomy.

5.1. Conclusions

The conclusions derived from the data results can be summarized into seven dimensions:

a) Specific facts concluded after examining various nations' astronomy programs:

- The majority of the nations have astronomy programs in their national science curriculums, which are distributed homogenously according to the appropriate grade level in elementary and secondary schools.
- The majority of the nations have determined the astronomy standards in their astronomy programs.

- Most countries teach the astronomy topics as parts of the existing main courses (Earth Science, Natural Science etc.) in elementary and secondary schools.
- There is parallelism between the National Science Curriculum of Turkey and various nations' science curriculums with respect to astronomy programs, especially in elementary level. However, astronomy programs in elementary level are not homogenously distributed considering specific standards in Turkey.
- There is not any astronomy program either as separate or as an under existing course in secondary school level of the National Science Curriculum of Turkey.

b) Opinions of the elementary and secondary schools' students and teachers about the content of the astronomy course:

- Elementary school students' rank the astronomy topics from the most important to the least. The most favorable topic is the motion of the Sun and the Planets; however, the least one is the concept of time and calendar. When the secondary school students' opinions are viewed, it is seen that the most favorable topic is stars and huge celestial bodies; however, the least one is light and shadow.
- Compared to the other subjects, elementary and secondary school students prefer light and shadow, mass gravity force and the effects of it on the objects, history of astronomy, and the concept of time and calendar the less. As for the teachers, the astronomy subjects that are preferred the less are history of astronomy, relativity, light and shadow, telescopes and satellites and their usage, stars and huge celestial bodies, other life forms and other solar systems, expansion of the universe and its faith, and horoscope signs. Therefore, these results can form a standard for a possible astronomy program's content.

- Virtual lines in the sky: horoscopes signs, which in fact do not belong to an area astronomy deals with, were put in the Q-DESO , but the majority of the elementary and secondary school students accept that this subject has a place in astronomy course.
- The most favorable subject to teach in the astronomy course for the teachers is astronomy subjects related with the daily life facts (the others included the subjects related with current development of the astronomy, the projects prepared related with astronomy, and the history of the astronomy).
- Teachers suggest that "the effects of the Sun on the life on Earth" was the most necessary subject that must be included in the courses. However, the least popular topic was "virtual lines in the sky: horoscopes signs".
- The opinions of the teachers about the appropriate astronomy subjects for the grade levels can be classified into tree parts. Those are grades between 4^{th} and 5^{th} (The concept of time and calendars, The relationships of the Sun, the Earth and the Moon with each other, The motion of the Earth in a day and around the Sun, The effects of the Sun on the life on the Earth, Light and shadow), between 6^{th} and 8^{th} (The motion of the Sun and the planets, Axis inclination of the Earth and its results, Telescopes, satellites and their usages, Mass gravity force and the effects of it on the objects), and between 9^{th} and 11^{th} (Space studies, Stars and huge celestial bodies, The role of gravity force in the solar system, Form of the universe and its evolution, Relativity, Expansion of the universe and its fate, History of the astronomy, Other life forms and other solar systems).

c) Opinions of the elementary and secondary schools' students and teachers about the teaching and learning methods in the astronomy course:

- The majority of the students at elementary schools regard the clarity of the instructions and the information as the most important component to learn the astronomy subjects better. However, the majority of the secondary school students regard making connections with daily life experiences as the most useful method to learn the astronomy subjects better. The majority of the teachers suggest that making connections with daily life experiences as the most important technique to teach the astronomy subjects better.
- A great part of the elementary school students, the students attending secondary schools, and teachers consider that experiments and observations were the most helpful methods to learn the subjects better.

d) Opinions of the elementary and secondary schools' students and teachers about the evaluation process in the astronomy course:

- A great number of students of elementary schools, students of secondary schools, and teachers prefer an evaluation process that includes the skills of performing, the observations, and experiments.

e) Opinions of the elementary and secondary school students about the learning environment and facilities in the astronomy course:

- The greater part of the elementary and secondary school students regard the environment where there is cooperation between the teacher and the students as having the highest importance to learn the astronomy subjects better.

- Most of the elementary school students select facilities including devices like TV and video as the initial preference to learn the subject matters better. However, most of the secondary school students select facilities that include laboratories where there are materials and models

related with the astronomy subjects as the first preference to learn the subject matters better.

f) Opinions of the elementary and secondary schools' students and teachers about the significance of the astronomy course:

- A large number of elementary and secondary school students believe that astronomy provided information and recognition of the Earth and the Universe.
- The most favorable choice of the elementary and secondary school students to share and exchange the qualified knowledge gained about astronomy was viewing photos and watching films and documentaries about astronomy.
- 91.20% of the elementary school students believe that astronomy affects the science and technology positively. Similarly, 87.40% of the secondary school students also believe that astronomy affects the science and technology certainly in a positive way.
- Teachers believe that the astronomy subjects must be taught under an existing course for the grade levels between kindergarten and 3^{rd} and they also believe that the astronomy subjects must be taught under an existing course for the grade levels between 4^{th} and 5^{th}. Conversely, for the grade levels between 6^{th} and 8^{th} and between 9^{th} and 11^{th}, the astronomy subjects are decided to be taught under a separate course by the teachers

g) Correlation between demographic characteristic of the students and their preference of the content of the astronomy course:

- In the elementary school students' data, female students compared to the male favor astronomy under a separate course more. Likewise, in

the secondary school students' data, it is concluded that female students compared to the male favor astronomy under a separate course more.

- The data collected from elementary school students shows that when the grade levels increase, the preference of the astronomy under a separate course becomes more favorable, and this parallelism exists in other preference types, which shows that the preference of the astronomy course under an existing course becomes less when the grade levels increase. Furthermore, for the secondary school students, when the school types are concerned, the preference of the astronomy under a separate course becomes more favorable for the students at secondary schools with one year preparation class rather than the regular and Anatolian High schools.
- From the elementary school students' data, it can easily be concluded that there is a significant difference between the preference of the astronomy course under a separate course and education levels of the parents. When the parents education status increase, the preference of the astronomy course under a separate course also increase.
- In the secondary school students' data, parents' education level of the students cause a slight difference for the preferences of the astronomy course. Students whose mothers graduated from elementary and middle schools want to have the astronomy course under a separate course more. However, students whose mothers graduated from secondary schools and universities do not prefer the astronomy course under a separate course that much compared to the students whose mothers are elementary and secondary school graduates. Finally, it can be claimed that as the students' mothers' education status increase, the preference of the astronomy course under a separate course decreases. Education levels that include illiteracy and college have a small number in the sample size and they can be ignored. Father education level of the students who prefer the astronomy course under a separate course is mostly middle school. Except the secondary school education level,

when the students' fathers' education status increase, the preference of the astronomy course under a separate course decreases. The sample of the students whose fathers graduated from college can also be ignored.

5.2. Discussion

When the data related with the sub-problems in the study is compared to the literature, there are some similarities in terms of distribution of the astronomy subjects in the grade levels. While elementary schools students preferred more concrete topics, secondary school students preferred more abstract topics in the questionnaires. In addition, the teachers listed the given astronomy subjects in a way that more concrete subjects take place in elementary education and more abstract subjects have a wider place in secondary education. This classification is in harmony with the astronomy content distribution in the literature. In the international astronomy programs, the topics are listed from concrete to abstract ones and placed in the programs according to age and grade levels.

However, there are no relevant studies and data in the literature related with the other sub-problems of the study, which are students' opinions about teaching and learning methods, evaluation period, educational atmosphere and facilities, significance of the astronomy course, and the relationship between the students' demographic features and preference of astronomy.

The data about the connection between the students' demographic features and their astronomy preference show interesting results. First of all, the gender difference plays an important role in the preference of astronomy. Female students seem to support an astronomy education under a separate course more than male students. The reasons are unknown and open to further research.

Parent education status also have an important effect on the students' astronomy preference. At elementary schools, as the parents' education level increase, the students' preference of astronomy education under a separate course increases. On the contrary, at secondary schools there is a converse

tendency. This might be derived from many reasons. These results may be connected with the theory of the integrative science. Integrative science was firstly defined by Menas Kafatos for a science that explains both structural and phenomenological aspects of reality. Integrative science is based on the connection of the all field of the human experiences, and foundational principles that cut across different levels (Kafatos, 2000). It is based on the concept of the combination of the connected discipliners. It starts from the whole to study the parts and tries to define concepts using related disciplines in a whole picture (Kafatos, 2000). In recent years, the idea of integration of the disciplines (such as physics, chemistry and biology) becomes a new approach in the education. Many nations have developed the integrated science programs in their education programs. For the secondary school education, as the parents education level increase, the students tendency to study the astronomy subject under an existing course increase. This might indicate that educated parents might not support a separate astronomy course. They might believe that the astronomy and related disciplines should be associated with each other and the topics of astronomy could be taught as an integrated science programs, which shows the parallelism between the literature related with integrated science approach and the results.

The other result was gathered about the grade levels in elementary schools. As the grade levels increase, preferring astronomy under a separate course also increase. One important reason might be their cognitive development. As their age level and educational experience related to astronomy topics increase, they might be more eager to study those topics deeply in a separate astronomy course.

The last result about demographic features is related with the relationship between secondary school types and astronomy preference. Students of Secondary Schools with one year English preparatory class prefer a separate astronomy course the most; whereas, the students of Anatolian High Schools prefer such a course the least compared to the other secondary school types. Especially the results of Anatolian High Schools are striking. The reasons might be various; however, when we view the reasons which they

wrote in the open ended question part of their answers related with astronomy preference, most of the students stated that their education program at school has already a heavy load, so the ones who are interested in this field can fulfill their needs outside the school.

5.2.1. Internal Validity of the Study

Internal validity of a study can be defined as the extent of control over extraneous variables. Extraneous variables are taught of as threats since they affect the study negatively. In this study, it is not possible to eliminate extraneous variables perfectly. In this study the utmost conditions were tried to be settled as much as possible to control the extraneous variables. However, this study is a cross – sectional survey study and there are specific extraneous variables that may affect the validation of the study's findings. These are history, mortality, location, instrumentation, and instrument decay.

History can create an atmosphere in which the subjects are affected during the study. It refers to extraneous incidents or events affecting the results that occur during the research (McMillan & Schumacher, 2001, p.186). The time of day could constitute a history threat in this study since the questionnaires were randomly given the subjects in different sections of the day. According to McMillan and Schumacher (2001), in experimental studies where one treatment is in the morning and the other is in the afternoon, time of the day would constitute a history threat. Although history is not threat to cross – sectional studies which are conducted at one time point, the importance of this threat for this study is the time of day. The great part of the subjects took the questionnaires in the morning; however, small part of subjects that could be ignored took the questionnaires in the afternoon. These facts could affect the results of the study inevitable. However, the distribution and number of the subjects were too wide to control the effect of time. For instance, some classes had course only in the afternoons and some had only in the mornings.

Another extraneous threat is mortality (subject attrition) that refers to the loss or absence of the subjects during the investigation, which might affect

the results of the study. McMillan and Schumacher (2001) assert that mortality is a serious threat to internal validity and this threat can be faced in many longitudinal studies that last over several weeks or months. Some subjects could drop out of the survey for many reasons, for example, they might not be present in the class and might just not want to answer the questionnaires, or lastly the administration might not give permission. In this study, it can be claimed that this threat is eliminated as much as possible by the researcher. To abandon this threat, direct administration was used and the researcher was present in the classes when the questionnaires were applied during the study. Despite all attempts, a very small number of subjects were lost. The number of subjects selected for the study was 3500 at the beginning of the study. This number was 3313 at the end of the study. It means that 94% of the questionnaires got back during the study. 55 schools were randomly selected for the study, however, one elementary school was removed from the study since the school principal did not allow the application of the questionnaire in the school although there was the letter of authority of the researcher gathered from the National Ministry of Education. 34% of teachers' questionnaires were returned in the study. This percentage was low, but most of them complained about the lack of time and lack of knowledge to fill in the questionnaires. Lastly, some questionnaires were not answered by some of the participants; however, the number of these questionnaires did not significantly affect the study findings.

Location is another threat to the interval validity. Location threat means the particular location in which data are collected, which may bring about negative impact on the results and may affect the responses of the subjects. For example, noisy or poorly lighted rooms, uncomfortable physical arrangement of the classrooms, and problems derived from mental defective students can be given as a location threat. In order to control of the location threat, the same conditions should be created for all participants. In this study, the location threat may effect the decision of the participants because the large sample and collecting the data in different districts make the local threat inevitable. However, the problems of locations were tried to be solved in different ways.

For example, students sitting in desk with more than two were sent to other desks; the desks which made writing difficult because of wide scratches were changed; and students who did not want to participate in the survey and created noise problems were sent out of the classrooms.

Instrumentation and instrument decay are threats related with changes of the instruments over time. Instrumentation was not a problem in this survey because the same instruments were used for all subjects and were conducted only once. The questionnaire items were short and concise.

5.2.2. External Validity of the Study

The generalizability of a research's results can be named as external validity. External validity can be classified into two types as population external validity and ecological external validity.

Population validity is achieved when the results of a study can be generalized to a more specified and larger group. In Ankara, there are 70750 students in regular state schools. 36750 of them attend in 5th and 7th grade, and 36000 of them attend in 10th grade. 2133 students were selected from 5th and 7th grades, which consist of 5.8% of all the students in 5th and 7th grade. Also, 1180 students were selected from 10th grade, which make 3.5% of all the students in 10th grade. This selected sample, which constitutes 4.7% of the target population, could be generalized to the overall population in 5th, 7th, and 10th grades. On the other hand, 110 teachers were aimed to be included in the study as a sample, yet only 37 of them could answer the questionnaires. Therefore, this number may not be generalized to the number of all teachers in Ankara; however, this sample can be used for getting initial opinions of the teachers about the subject.

Creating appropriate environmental conditions fosters ecological validity. These are explicit description of the survey, Hawthorne effect, and the effect of researcher. In this study, the questionnaires, its aim, and the items were described in detail, so explicit description of the survey was done in an objective way. Hawthorn effect can be described as the awareness of the

subject that s/he is participating in a study. In order to minimize this factor, the researcher tried not to give a special attention to the survey, and tried to implement it in a natural environment. Lastly, to eliminate the effect of researcher, personal information about the researcher was not given to the subjects in case they might feel close or hostile towards the researcher.

5.3. Implications

Initially, the results collected in this study should be used while preparing an astronomy program for elementary and secondary school education. The other implications that should be considered while preparing astronomy program are listed in 10 items:

- Astronomy topics that are included as parts of the main courses in the elementary schools should be revised and rearranged in the elementary school education program and a new program should be progressed for elementary level.
- An astronomy program should be developed for secondary school education.
- When the astronomy program is prepared for elementary school students, concrete topics should be involved in the program. A great number of students support clear and understandable astronomy topics, and abstract topics are not mentioned as favorable topics by the elementary school students.
- Secondary school students want to see the more exciting and interesting topics in the astronomy program; therefore, there should be more attractive and useful astronomy topics in the program.
- The astronomy topics including the relationships among the Earth, the Sun and the Moon are more necessary subjects according to the teachers. The opinions of the teachers about the necessity of different topics might be taken into consideration during the process of

development of the astronomy program. Similarly, the teachers' opinions about the appropriate level of the astronomy subjects also should be kept in mind.

- Clarity of the instruction and making connections with daily life experiences are essential components for the teachers and the students to learn the astronomy subjects better. Moreover, students and teachers believe that experiments and observations are the most helpful methods to learn the subjects better. Therefore, these components should be considered carefully during the period of determination of criteria about the teaching and learning methods in the astronomy program.
- The evaluation of the astronomy subjects should be based on the skills of performing, the observations and experiments according to the teachers and students. For this reason, these opinions of the teachers and students should be given importance during the development of the astronomy program.
- According to elementary and secondary school students, the environment where there is cooperation between the teacher and the students is an important component for an effective learning environment, and including devices like TV and video, and laboratories where there are materials and models related with the astronomy subjects are crucial facilities in order to learn the subjects better. For this reason, these kinds of teaching – learning environment and facilities should be considered in the development of the astronomy program.
- The great number of the elementary and secondary school students claim that viewing photos and watching films and documentaries about astronomy will be the best way to share and exchange the qualified knowledge gained about astronomy; therefore, the opinions of the students about significance of the astronomy program are necessary and should interest the program developers.

- The majority of elementary and secondary school students accept that astronomy affects the science and technology positively. For this reason, there should be strongly emphasized on the relationship between astronomy and technology in a possible astronomy program.

5.4. Recommendations for Further Studies

Recommendations for researchers:

In this study, only the students and the teachers' opinions were collected. These constitute only a small group of the stakeholders, who are directly related with teaching and learning process. As a further study, parents, administrators, program developers, and astronomy lecturers could be included in a research, also their opinions could be gathered. Lastly, further researches about the reasons of the data gathered in this study related with the relationship between the students' demographic features and their astronomy preference are needed.

Recommendations for program developers:

In the light of these research results, program developers could develop an astronomy program suitable for the goals of Ministry of Education, the opinions of the subjects questioned in the study could be applied, and the program could be based on these. Furthermore, an experimental study group for this program could be selected and the feasibility of the program could be tested by the program makers.

Recommendations for the practitioners:

Based on the results achieved in this study, the practitioners could use the teaching and learning methods including daily life experiences, experiments and observations, create an educational atmosphere where

teachers and the students cooperate, use visual facilities; and finally, they could use performance based evaluation, so they could search these aspects' efficiency on the students success in astronomy education.

REFERENCES

Adams, P. J., & Stater, F. T. (2000). Astronomy in the National Science Education Standards. *Geoscience Education, 48*(1), 39-45.

Ainsworth, P. (2001). Changes in Accounting Curricula: Discussion and Design. *Accounting Education, 10*(3), 279-297.

Alberta's Kindergarten to Grade 12 Curriculum: Programs of Studies, http://www.learning.gov.ab.ca/k_12/curriculum/bySubject/default.asp#ecs, Last access date October 2004.

American Association for the Advancement of Science. (1993). *Benchmarks for Science Literacy*. Retrieved June 02, 2004 from www.project2061.org.

American Association for the Advancement of Science. (2001). *Atlas of Science Literacy*. American Association for the Advancement of Science and National Science Teachers Association, Washington, D.C.

Aslan, Z., Aydın, C., Demircan, O., Kırbıyık, H., & Derman, E. (1996). *Astronomi ve Uzay Bilimleri Ders Kitabı*. Tekışık Yayıncılık: Ankara.

Atwood & Atwood (1996). Preservice Elementary Teachers' Conceptions of the Causes of Seasons. *Journal of Research in Science Teaching, 33*(5), 553-563.

Ayas, A., Çepni, S., & Akdeniz, R. A. (1993). Development of the Turkish Secondary Science Curriculum. *Science Education, 77*(4), 433-440.

Barnett, M. (2000). Addressing Children's Alternative Frameworks of the Moon's Phases and Eclipses. *International Journal of Science Education, 24*(8), 859-879

Barnett, R., Parry, G., & Coate, K. (2001). Conceptualizing Curriculum Change. *Teaching in Higher Education, 6*(4), 435-449.

Baxter, J. (1989). Children Understanding of Familiar Astronomical Events. *International Journal of Science Education, 11*, 502-513.

Beck, R. H., Cook, W. W. & Kearney, N. C. (1956). *Curriculum in the Modern Elementary School*. Prentice – Hall: New Jersey.

Bishop, G. (1995). *Curriculum Development a Textbook for Students*. Macmillan Education LTD: London.

Board of Studies (1998). *Science Stages 4-5 Syllabus*. Board of Studies: Sidney.

Brickhouse, W. N., Dagher, R. Z., Letts, J. W., & Shipman, L. H. (2000). Diversity of Students' View about Evidence, Theory, and the Interface between Science and Religion in an Astronomy Course. *Journal of Research in Science Teaching, 37*(4), 340-362

Brickhouse, W. N., Dagher, R. Z., Shipman, L. H., & Letts, J. W. (2002). Evidence and Warrants for Belief in College Astronomy Course. *Science and Education, 11*, 573-588.

Bruner, S. J. (1966). *Toward a Theory of Instructions*. Cambridge: Harvard University.

Callision, P. L., & Wright, E. L. (1993). *The Effect of Teaching Strategies Using Models on Preservice Elementary Teachers' Conceptions about Earth-Sun-Moon Relationship*. ERIC Document ED 360 171.

Chamlis, C. R. (1990). *A Planetarium Oriented Sequence of Exercise. In the Teaching Astronomy, H. M. Pasachoff and J. R. Percy (Eds.)*. Cambridge University Press: Cambridge.

Dai, M. F. W. (1991). *Identification of Misconceptions about the Moon Held by Fifth and Sixth-graders in Taiwan and Application for Teaching*: Dissertation Abstracts International.

Demirel, Ö. (2004). *Kuramdan Uygulamaya: Eğitimde Program Geliştirme*. Ankara: Pegem A Yayıncılık.

Department for Education and Employment (1999). *The National Curriculum for England*. HMSO: London

Diakiday, N. A. I., & Kendeou, P. (2001). Facilitating Conceptual Change in Astronomy: a Comparison of the Effectiveness of Two Instructional Approaches. *Learning and Instruction, 11*, 1-20.

Dick, W., & Carey, L. (1996). *Systematic Design of Instruction*. (4th ed.). Harper Collins.

Doğan, H. (1975). Program Geliştirmede Sistem Yaklaşımı. *Ankara Üniversitesi Eğitim Fakültesi Dergisi, Cilt: 7*, Sayı 14.

Elliott, J. (1991). *The fundamental Characteristics of Action Research: Action Research for Educational Change*. Milton Keynes: Open University.

Elliott, J. (2000). Revising the National Curriculum: A Comment on the Secretary of State's Proposals. *Journal of Education Policy, 15*(2), 247-255.

Ertürk, S. (1982). *Eğitimde Program Geliştirme*. Meteksan Lmt. Şti, Ankara

Frayer, D. A., Schween-Ghatala, E., & Klausmeier, H. J. (1972). Levels of Concept Mastery: Implications for Instruction. *Educational Technology, 12*(12), 23-29.

Galton, M. (2000). The National Curriculum Balance Sheet for Key Stage 2: A Researcher's View. *The Curriculum Journal, 11*(3), 323-341.

Hamilton, D. (1976). *Curriculum Evaluation*. London: Open Books.

Henson, T. K. (1995). *Curriculum Development for Education Reform*. New York: Donnelly & Suns Company.

Joyce, B., Calhoun, E. & Hopkins, D. (1997). *Models for Learning-tools for Teaching*. Buckingham: Open University.

Kasturirangan, K. (1997). Relevance and Challenges of Space Science Education in Developing Countries. *Advance Space Research, 20*(7), 1329-1333.

Kendall, S. J., DeFrees, L. K., & Richardson, A. (2003). *Sequenced benchmarks for K-8 Science*, http: //www.mcrel.org/PDF/Standards/5021TG_Science_Sequenced_bms.pdf., Last access date June 2004.

Knight, T. P. (2001). Complexity and Curriculum: A Process Approach to Curriculum-making. *Teaching in Higher Education, 6*(3), 369-381.

Koçak, D. (2002). *V. Fen Bilimleri ve Matematik Eğitimi Kongresi*, http://www.fedu.metu.edu.tr/ufbmek-5/b_kitabi/b_kitabi.htm., Last access date June 2004.

Leat, D., & Higgins, S. (2002). The Role of Powerful Pedagogical Strategies in Curriculum Development. *The Curriculum Journal, 13*(1), 71-85.

Lederman, G. N., Abd-El-Khalick, F., Bell, L. R., & Schwartz, S. R. (2002). View of Nature of Science Questionnaire: Toward Valid and Meaningful Assessment of Learners' Conceptions of Nature of Science. *Journal of Research in Science Teaching, 39*(6), 497-521.

Leonard, J. P. (1960). *Developing the Secondary School Curriculum.* Holt, Rinehart and Winston: London.

Lightman, A., & Sadler, P. (1993). Teacher Prediction versus Actual Students Gain. *Physics Teacher, 31*(3), 162-167.

Maddox, H., & Hoole, E. (1975). Performance Document in the Lecture. *Educational Review, 28*, 17-30.

Mali, G., & Howe, A. (1979). A Development of the Earth and Gravity Concepts Among Nepal Children. *Science Education, 63*(5), 685-691.

Marshall, C. (1991, March, April). Teachers' Learning Styles: How do They Affect Student Learning? *The Clearing House, 64* (4), 225-227.

McMillan, H. J. & Schumacher, S. (2001). *Research in Education: A Conceptual Introduction* (5th ed.). Addison Wesley Longman, Inc: USA.

McNally, D. (1982). Astronomy at School, *Physics Education. 17*, 157-160.

McNeil, J. D. (1996). *Curriculum – A compressive Introduction.* (5th ed.).Harper Collins College Publisher: USA.

Michaelis, U. J., Grossman, H. R., & Scott, F. L. (1967). *New Design of Elementary Curriculum and Instruction*. New York: McGraw-Hill Book Company.

Morrow, C. A (1998). Innovations in the Teaching of Astronomy: Paper Presented at American Association of Physics Teacher Meeting. *AAPT Announcer, 27*(4), p.134.

Multisilta, J. (1997). Learning Environments on the World Wide Web: Experiences from Astronomy on-line. *Education and Information Technologies, 2*, 171-177.

National Research Council (1996). *National Science Education Standards*. Washington: National Academy of Science Press: Washington, D.C.

Naysbaum, J. (1979). Children' Conception of the Earth as a Cosmic Body: A Cross Age Study. *Science Education, 63*(1), 83-93.

New Jersey Core Curriculum Standards. (n.d). Retrieved October 16, 2004, from http://www.state.nj.us/njded/cccs/s5_science.htm#58.

Oliva, P. T. & Pawlas, G. E. (2001). *Supervision for Today's Schools.* (6th ed.). John Wiley & Sons, Inc : USA.

Oliva, P. T. (2001). *Developing the Curriculum.* (5th ed.). Longman: USA.

Oliva, P.F. (1992). *Developing the Curriculum.* (3rd ed.). New York: Harper-Collins.

Ornstein, A. C. & Hunkins, F. P. (1988). *Curriculum: Foundations, Principles, and Issues.* Prentice Hall: New Jersey.

Osborne, R. J., & Gilbert, J. K. (1980). A Method for Investigating Concept Understanding in Science. *European Journal of Science Education, 2*, 311-371.

Outline of the Turkish Education System, http://www.yok.gov.tr/webeng/outline.html., Last access date April 2006.

Parker, J. (2003). Reconceptualizing the Curriculum from Commodification to Transformation. *Teaching in Higher Education, 8*(4), 529-543.

Pena, M. B., & Gil Quilez, M. J. (2001). The Importance of Images in Astronomy Education. *International Journal of Science Education, 23*(11), 1125-1135.

Percy, D. G. (1990). *The Teaching of Astronomy*. Cambridge: Cambridge University Press, UK.

Percy, R. J. (1998). Astronomy Education: An International Perspective. *Astrophysics and Space Science, 258*, 347-355.

Phenix, H. P. (1964). *Realms of Meaning*. McGraw Hill: New York

Philips, W. C. (1991). Earth Science Misconceptions. *The Science Teacher, 58* (2), 21-23.

Piaget, J. (1954). *The Construction of the Validity in the Child*. Basic Books: New York.

Reed, G. (1972). A Comparison of the Effectiveness of the Planetarium and the Classroom Chalkboard and Celestial Globe in the Teaching of the Specific Astronomy Concepts. *School Science and Mathematics, 72*(5), 368-374.

Roettger, E. E. (1998). *Changing View of the Universe*. *Paper Presented at American Association of Physics Teacher Meeting*, New Orleans: USA.

Rollins, M. M., Dentton, J. J., & Janke, D. L. (1983). Attainment of Selected Earth Science Concepts by Texas High School Seniors. *The Journal of Educational Research, 72*(2), 83-88.

Rycroft, J. M. (1997). Space Science Education – An Interdisciplinary and International Programme. *Advance Space Research, 20*(7), 1335-1339.

Sadler, P. (1992). *The Initial Knowledge State of High School Astronomy Students*. Ed. D. Dissertation, Harvard School of Education.

Saylor, G. J., & Alexander, M. W. (1964). *Curriculum Planning for Better Teaching and Learning*. Holt, Rinehart and Winston: New York.

Schneps, M. H. (1987). *A Private Universe: Available from Pyramid Films and Video*. Santa Monica: USA.

Science in the New Zealand Curriculum, http://www.minedu.govt.nz/web/downloadable/d13525 v/1sci-nzc.pdf., Last access date October 2004.

Selvi, K., & Yaşar, Ş. (1997). Ortaöğretim Fen Eğitimi Programlarının Değerlendirilmesi. *4. Ulusal Eğitim Bilimleri Kongresi Bildirileri 1: Program Geliştirme Öğretmen Yetiştirme Yaygın Eğitim*, Anadolu Üniversitesi, Eskişehir, Türkiye

Skamp, K. (1994). Determining Misconceptions about Astronomy. *Australian Science Teachers Journal, 40*(3), 63-67.

Slater, T. F. (1993). *The Effectiveness of a Constructivist Epistemology Approach to the Astronomy Education of Elementary and Middle Level in Service Teachers*: Ph. D. Dissertation, University of South California.

Smith, A. H. (2003). Public Attitudes towards Space Science. *Space Science Reviews, 105*, 493-505.

Sneider, C., & Pulos, S. (1983). Children's Cosmographies: Understanding the Earth's Shape and Gravity. *Science Education, 67*(2), 205-221.

Sowell, E. J. (2001). *Curriculum – An Integrative Introduction.* (1st ed.). McGraw Hill: Boston.

Squire, D. K., Makinster, G. J., Barnett, M., Luehman, L. A., & Barab, L. S. (2001). Design Curriculum and Local Culture: Acknowledging the Primary of Classroom Culture. *Presented at the 2001 Annual Meeting of the American Educational Research Association*, Seattle: USA.

Stenhouse, K. (1975). *An Introduction to Curriculum Research and Development*. Heinemann: London.

Tanner, D. & Tanner, L. (1995). *Curriculum Development: Theory into Practice*. Prentice – Hall: New Jersey.

Taylor, I., Barker, M., & Jones, A. (2003). Promoting Mental Model Building in Astronomy Education. *International Journal of Science Education, 25*(10), 1205-1225.

Taylor, V. S., & Sobel, M. D. (2003). Rich Contexts to Emphasize Social Justice in Teacher Education: Curriculum and Pedagogy in Professional Development Schools. *Equity and Excellence in Education, 36*, 249-258.

Treagust, D. F., & Smith, C. L. (1989). Secondary Students Understanding of Gravity and the Notions of Planets. *School Science and Mathematics, 89*(5), 380-391.

Trumper, R. (2001). A Cross-college Age Study of Science and Nonscience Students' Conceptions of Basic Astronomy Concepts in Preservice Training for High School Teachers. *Journal of Science Education, 10*(2), 189-195.

Tunca, Z. (2002). *V. Fen Bilimleri ve Matematik Eğitimi Kongresi*, http://www.fedu.metu.edu.tr/ufbmek-5/b_kitabi/b_kitabi.htm., Last access date June 2004.

Tyler, R. (1949). *The Basic Principles of Curriculum and Instruction*. University of Chicago Press: Chicago.

Urama, O. J. (2002). The Challenges of Astronomy in Nigeria. *Physica Scripa, 97*, 20-23.

Varış, F. (1994). *Eğitimde Program Geliştirme*. Teori ve Teknikler. Ankara: Alkım Yayıncılık.

Vosniadou, S. (1992). *Designing Curriculum for Conceptual Restructuring: Lessons from the Study of Knowledge Acquisition in Astronomy*. ERIC Document, ED 404 098.

Warren, J. (2003). Changing Community and Technical College Curricula to a Learning Outcomes Approach. *Community College Journal of Research and Practice, 27*, 721-730.

Wentzel, D. (1990). *The Teaching of Astronomy*. Cambridge University Press: Cambridge

Whitehead, N. A. (1970). *The Aims of Education and Other Essays (seventh impression)*. London.

Williams, D. R. (1969). *Cross-cultural Studies*. Regain: London.

Yiğit, N. (2002). The Role of Teacher in Curriculum Development Process. *Çağdaş Eğitim Dergisi*, *296*, 27-33.

Yüksel, S. (2003). Türkiye'de Program Geliştirme Çalışmaları ve Sorunları. *Milli Eğitim Dergisi, 159*, 120-124.

Zimmerman, C. (2003). The Impact of the MARS Curriculum on Students' Ability to Coordinate Theory and Evidence. *International Journal of Science Education, 25*(10), 1247-1271.

APPENDIX A

ASTRONOMY OBJECTIVES FROM DIFFERENT STATES IN UNITED STATES OF AMERICA

Arizona Science Standards, www.libraryvideo.com/servlet/pdfmaker/cc/15393/V1TB0URQPV5C8HJG2V4N5GTKJMJGAE4E/N6671arizona.pdf, Last access date October 2004.

Table A.1. Astronomy Objectives in Arizona Science Standards

State	Standard	Performance Objective	Behavioral Objective	Grade Level Required
Arizona Science Standards	Earth and Space Science: students understand the composition, formative process, and history of the Earth, the solar system, and the universe (STANDARD 6)	PO 1.Distinguish between revolution and rotation	Describe and model the motion of the Earth in relation to the Sun, including the concepts of day, night, season, and year	5 (Elementary Level)
		PO 1.Describe common objects in the solar system	Describe common objects in the solar system and explain their relationships	5 (Elementary Level)
		PO 2.Explain how objects in the solar system are related	Describe common objects in the solar system and explain their relationships	5 (Elementary Level)
		PO 1.Describe the properties and the composition of the layers of the atmosphere	Describe the composition of, properties and structure of the atmosphere	5 (Elementary Level)
		PO 2.Explain the impact of technology on space science	Explain how technology has impacted both the Earth and space science	5 (Elementary Level)
		PO 1.Explain the motion of the Earth in relation to the Sun, including the concepts of the day, night, seasons, and year	Describe and model the motion of the Earth in relation to the Sun, including the concepts of day, night, season, and year	6-8 (Middle School)
		PO 1.Describe the common objects in the solar system galaxy and the universe	Describe common objects in the solar system and explain their relationships	6-8 (Middle School)

Arkansas Science Standards, www.libraryvideo.com/servlet/ pdfmaker/cc/15432/N6671kansas.pdf, Last access date October 2004.

Table A.2. Astronomy Objectives in Arkansas Science Standards

State	Strand	Performance Objective	Rational	Grade Level Required
Arkansas Science Standards	Earth and Space Science systems (STRAND 3)	ES.1.6.Understand the relationships between the Earth and objects in space	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	5-8
		ES.1.12.Explain and compare the properties (gravity, size, shape, distance, and color) of objects in the solar system	Students will explore, demonstrate, communicate, apply and evaluate the knowledge of the properties of the Earth and space systems.	5-8
		ES.2.13.Explore past, present, and future space technology	Students will explore, demonstrate, communicate, apply and evaluate the knowledge of the properties of the Earth and space systems.	5-8
		ES.2.14.Relate the physical characteristics of the Sun to other stars	Students will explore, demonstrate, communicate, apply and evaluate the knowledge of the properties of the Earth and space systems.	5-8

Chicago Science Standards, www.libraryvideo.com/servlet/ pdfmaker/cc/1061/N6671chicago.pdf, Last access date October 2004.

Table A.3. Astronomy Objectives in Chicago Science Standards

State	Standard	Performance Objective	Benchmark	Grade Level Required
Chicago Science Standards	Have a working knowledge of the fundamental concepts and principles of the life, physical, and Earth/Space sciences and their connections	SG (State Goal). 12.Explain how planets change their position in the sky relative to stars	Compare the composition, structure, and formation of celestial objects in the space with those on the Earth	5
		SG.12.Compare the relative sizes, positions, and motions of the bodies within and beyond the solar system	Compare the composition, structure, and formation of celestial objects in the space with those on the Earth	6
		SG.12.Describe the relationship of the Sun to other components of the galaxy (e.g. stars, star clusters)	Describe large-scale dynamic processes occurring in the solar system and beyond	7
		SG.12.Describe the major features of the solar system including the nine planets, their respective moons, comets, and asteroids	Describe large-scale dynamic processes occurring in the solar system and beyond	8

Florida Science Standards, www.libraryvideo.com/servlet/pdfmaker/cc/1064/V1TB0URQPV5C8HJG2V4N5GTKJMJGAE4E/N6671florida.pdf, Last access date October 2004.

Table A.4. Astronomy Objectives in Florida Science Standards

State	Standard	Performance Objective	Grade Level Required
Florida Science Standards	Earth and Space Science	1.3.5.Understands concepts of time and size relating to the interaction of the Earth's processes	6-8
		1.The student understands the interaction and organization in the Solar System and the Universe and how this effects life on the Earth	5-8
		1.2.4.Knows that the planets differ in size, characteristics, and composition and that they orbit the Sun in our Solar System	5
		1.2.5.Understands the arrangement of the planets in our Solar System	5
		1.3.1.Understand the vast size of our Solar System and the relationship of the planets and their satellites	6-8
		1.3.3.The student recognizes the vastness of the Universe and the Earth' place in it	6-8
		2.Knows that, in addition to the Sun, there are many other stars that are far away	5-8
		2.2.1.Understands that our Sun is one of many stars in our galaxy	5
		2.3.1.Knows that thousands of other galaxies appear to have the same elements, forces, and forms of energy found in our Solar System	6-8

Indiana Science Standards, www.libraryvideo.com/servlet/pdfmaker/cc/15422/N6671indiana.pdf, Last access date October 2004.

Table A.5. Astronomy Objectives in Indiana Science Standards

State	Standard	Objective	Grade Level Required
Indiana Science Standards	Earth and Space Science	The patterns of the stars in the sky stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons	5
		Telescopes magnify the appearance of the some distant objects in the sky, including the Moon and the planets	

Table A.5 (cont'd)

		telescopes is dramatically grater that can be seen by the unaided eye	
		Planets change their positions against the background of stars	
		The Earth is one of several planets that orbit the Sun, and the Moon orbits around the Earth	
		Stars are like the Sun, some being smaller and some larger, but so far away that they look like points of light	
		The Sun is medium-sized star located near the edge of a disk-shaped galaxy of stars, part of which can be seen as a glowing band of light that spans the sky on a very clear night. The universe contains many billions of galaxies, and each galaxy contains many billions of stars	6-8
		Nine planets of very different size, composition, and surface features move around the Sun in nearly circular orbits. Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geology activity. The Earth orbited by one moon, many artificial satellites, and debris	
		Large numbers of chunks of rock orbit the Sun. Some of those that the Earth meets in its yearly orbit around the Sun glow and disintegrate from friction as they plunge through the atmosphere and sometimes impact the ground. Other chunks of rocks mixed with ice have log off-center orbits that carry them close to the Sun, where the Sun's radiation (of light and particles) boils of frozen material from their surfaces and pushes it into a long, illuminated tail	
		Everything on or anywhere near the Earth is pulled toward the Earth's center by gravitational force	
		The Sun's gravitational pull holds the Earth and other planets in their orbits, just as the planets' gravitational pull keeps their motion in orbit around them	

Kansas Science Standard, www.libraryvideo.com/servlet/ pdfmaker/cc/15432/N6671kansas.pdf, Last access date October 2004.

Table A.6. Astronomy Objectives in Kansas Science Standards

State	Standard	Objective	Rational	Grade Level Required
Kansas Science Standards	Experiences in grades 5-8 will allow all students to study and develop an understanding of the structure and history of the Earth and the solar system (STANDARD 4)	7.1.Compare and contrast the characteristics of the planets	The students will identify and classify planets and other solar system components. The solar system consists of the Sun, which is an average-sized star in the middle of its life cycle, and the nine planets and their moons, asteroids, and comets, which travel in elliptical orbits around the Sun. The Sun, the central and largest body in the system, radiates energy outward. The Earth is the third of nine planets in the system, and has one moon. Other stars in our galaxy are visible from the Earth, as are distant galaxies, but they appear as pinpoints of light. Scientists have discovered much about the composition and size of stars, and how they move in space. Space and the solar system are of high interest to middle level students.	5-8
		7.2.Develop understanding of spatial relationships via models of the Earth/Moon/Pla nets/ Sun system to scale		
		3.Research smaller components of the solar system such as asteroids and comets		
		10.4.Identify the Sun as a star and compare its characteristics to those of other stars		
		5.Trace scientific influences on the study of astronomy		

Table A.6 (cont'd)

		10.3.Apply principles of force and motion to an understanding of the solar system	The students will model motions and identify forces that explain the Earth phenomena. There are many motions and forces that affect the Earth. Most objects in the solar system have regular motions, which can be tracked, measured, analyzed, and predicted. Such phenomena as the day, year, seasons, tides, phases of the Moon, eclipses of the Sun and Moon, can be explained by these motions. The force that governs the motions of the solar system, and keeps the planets in orbit around the Sun, and the Moon around the Earth, is gravity. Phenomena on the Earth's surface, such as winds, ocean currents, the water cycle, and the growth of plants, receive their energy from the Sun. Misconceptions abound among middle level students about such concepts as the cause of the seasons and the reasons for the phases of the Moon. Hands-on activities, role-playing, models, and computer simulations are helpful for understanding the relative motion of the planets and moons. Teachers can help students make connections between force and motion concepts, such as Newton's Laws of Motions and Newton's Law of Gravitational Force, and applications to the Earth and space science. Many ideas are misconceptions that could be considered in a series of "what if" questions: What if the Sun's energy did not cause cloud formation and other parts of the water cycle? What if the Earth rotated once a month? What if the Earth's axis was not tilted?	

The Maine Science Standards, www.libraryvideo.com/servlet/pdfmaker/cc/1105/XXA01H7LNCGH9GXP3UPKJ5E53L56C8WE/N6671mainescience.pdf, Last access date October 2004.

Table A.7. Astronomy Objectives in the Maine Science Standards

State	Standard	Performance Objective	Rationale	Grade Level Required
The Maine Science Standards	Earth and Space Science systems (GOAL)	2.Describe the concepts of the galaxies, including size and number of stars	Students will gain knowledge about the universe and how humans have learned about it, and about the principles upon which it operates	5-8
		3.Compare and contrast distance and the time required to travel those distance on the Earth, in the solar system, in the galaxy, and between galaxies		
		4.Describe scientists' exploration of space and the objects they have found (e.g. comets, asteroids, and pulsars)		
		5.Describe the motions of the moons, planets, stars, solar systems, and galaxies		

The Maryland Science Standards, www.libraryvideo.com/servlet/pdfmaker/cc/15452/4LJRLUGHDAPT9PVJ1JHU0TMTL1P72LNE/N6671marylandcore.pdf, Last access date October 2004.

Table A.8. Astronomy Objectives in the Maryland Science Standards

State	Standard	Performance Objective	Rationale	Grade Level Required
The Maryland Science Standards	Earth and Space Science systems	2.5.6.Describe how celestial objects (e.g. Sun, Moon, stars, planets) differ (i.e. properties, location, and movement). (AAAS, p.63)	In the Earth/Space science course, students will use scientific skills and processes to explain the chemical and physical interactions (i.e. natural forces and cycles, transfer of energy) of the environment, the Earth, and the universe that occur over time. Even before children begin their formal education, they study the Earth/Space	5
		2.5.8.Explain that the patterns of stars in the sky stay the same although		

Table A.8 (cont'd)

		the Sun. (AAAS, p.63)	science through observations of the world around them. Early instructional activities build on students' prior knowledge and help them focus their observations. This enables students to discover distinguishing properties of objects, patterns in movements, and cycles in the changes they observe. During the middle school years, students explore and examine the structure of the Earth and its relationship with other celestial objects. At the grade 12 levels, instruction is focused on geology, astronomy, oceanography, and meteorology.	
		2.8.6.Explain that there are billions and billions of galaxies and each galaxy contains billions of stars that are not able to be distinguished by the naked eye because of their great distance from the Earth (AAAS, p.64)		6-8
		2.8.7.Compare and classify celestial objects (e.g. stars, planets, moons, asteroids, comets, and meteors) according to sizes, compositions, and surface features (AAAS, p.65)		

South Dakota Science Standards, www.libraryvideo.com/servlet/pdfmaker/cc/1247/4LJRLUGHDAPT9PVJ1JHU0TMTL1P72LNE/N6671dakotacontent.pdf , Last access date October 2004.

Table A.9. Astronomy Objectives in South Dakota Science Standards

State	Standard	Performance Objective	Grade Level Required
South Dakota Science Standards	Earth and Space Science	Describe variety of components of the solar system	5
		Explain how patterns of stars remain the same even though patterns appear to move across the sky	
		Describe relative scale of the Earth to the Sun, planets, and Moon	
		Understand the organization of the solar system and relationships among the various bodies that comprise it (e.g. Sun, Moon, Earth, other planets, and their moons, meteors, asteroids, and comets)	6
		Compare revolution and rotation of the other planets to the Earth's	
		Compare and contrast characteristics of the Sun, Moon, Earth, other planets, and their moons, meteors, asteroids, and comets	7
		Compare the masses within the solar system using composition, size, and orbital motion	
		Describe the components of the universe	8
		Relate the discovery of the speed of light to how distance is measured in the universe	

Texas Science Standards, www.libraryvideo.com/servlet/ pdfmaker/cc/1263/N6671texas.pdf Last access date October 2004.

Table A.10. Astronomy Objectives in Texsas Science Standards

State	Standard	Performance Objective	Grade Level Required
Texas Science Standards	Earth and Space Science	112.7.Knows that the natural world includes the Earth materials and objects in the sky	5
		112.22.Identify and describe a system that results from the combination of two or more systems such as in the solar system	6
		112.22.Knows components of our solar system	
		112.22.Identify characteristics of objects in our solar system including the Sun, planets, meteorites, comets, asteroids, and moons	
		112.22.Describe types of equipment and transportation needed for space travel	
		112.23.Knows components of our solar system	7
		112.23.Identify and illustrate how the tilt of the Earth on its axis as it rotates and revolves around the Sun causes changes in seasons and the length of a day	
		112.24.Knows characteristics of the universe	8
		112.24.Describe characteristics of the universe such as stars and galaxies	
		112.24.Explain the use of light years to describe distance in the universe	

APPENDIX B

ASTRONOMY TOPICS IN SEQUENCED BENCHMARKS FOR K-8 PREPARED FOR THE U.S DEPARTMENT OF EDUCATION

Kendall, S. J., DeFrees, L. K., & Richardson, A. (2003). *Sequenced benchmarks for K-8 Science*, http://www.mcrel.org/PDF/Standards/5021TG_Science_Sequenced_bms.pdf., Last access date June 2004.

Table B.1. Astronomy Topics in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

Earth and Space Science
1. Characteristics of the Earth System
2. Earth's History
3. Earth's Surface Features
4. Energy in the Earth System
5. Motion of the Earth and Moon
6. Rocks, Minerals, and Soil
7. Seasons, Weather, and Climate
8. The Solar System
9. The Sun and Other Stars
10. The Universe

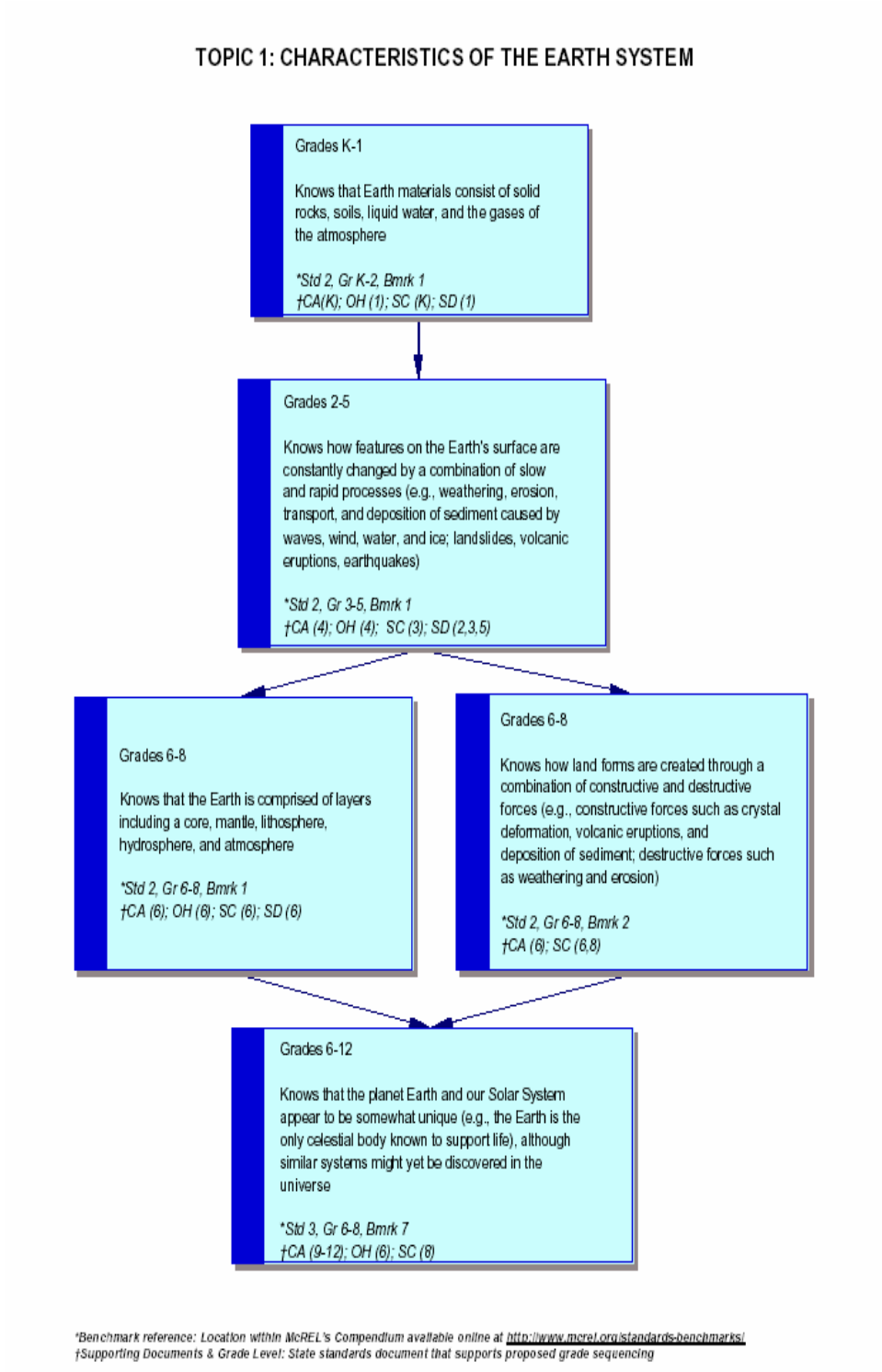


Figure B.1.Charecteristics of the Earth System in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

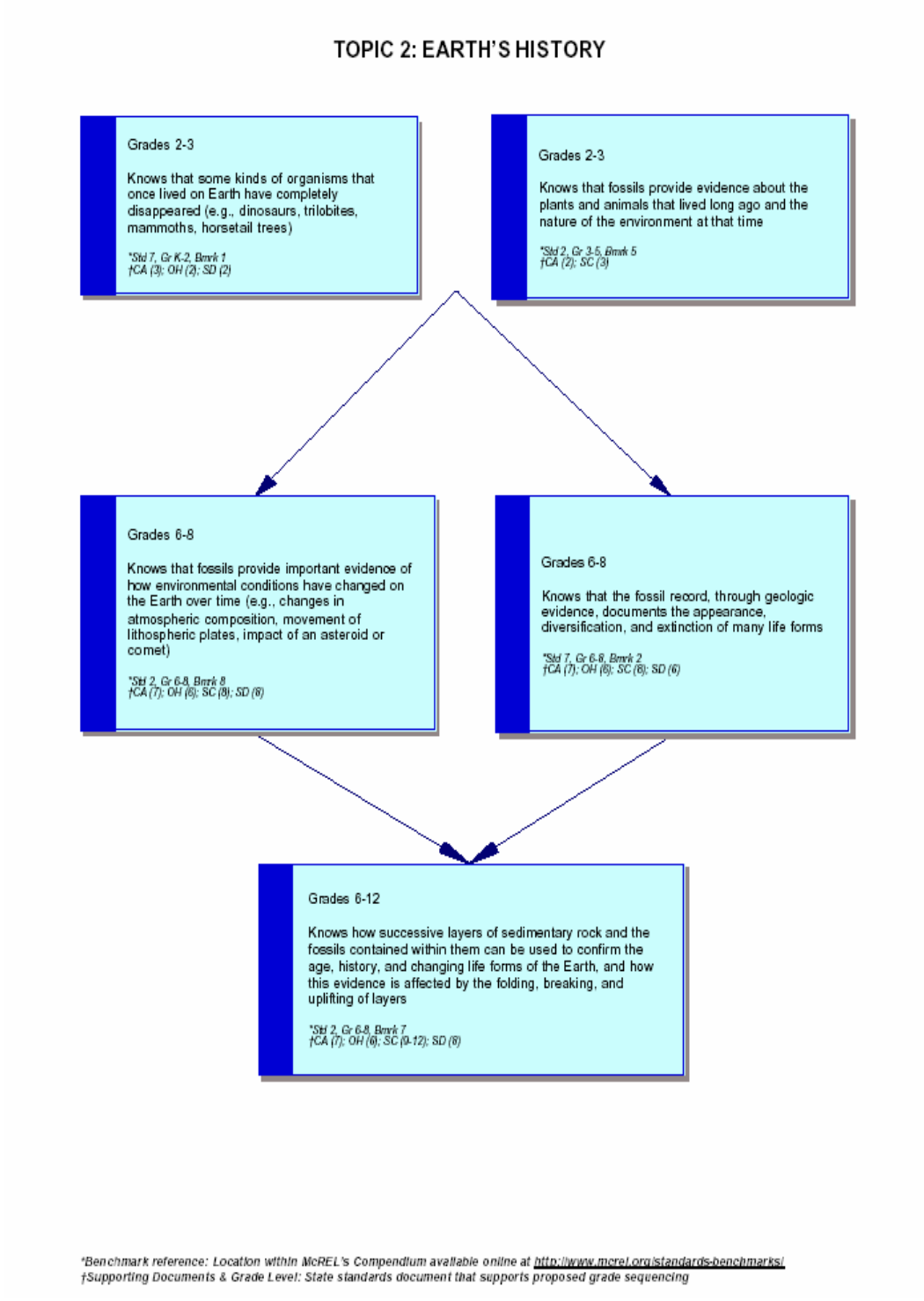


Figure B.2. The Earth's History in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

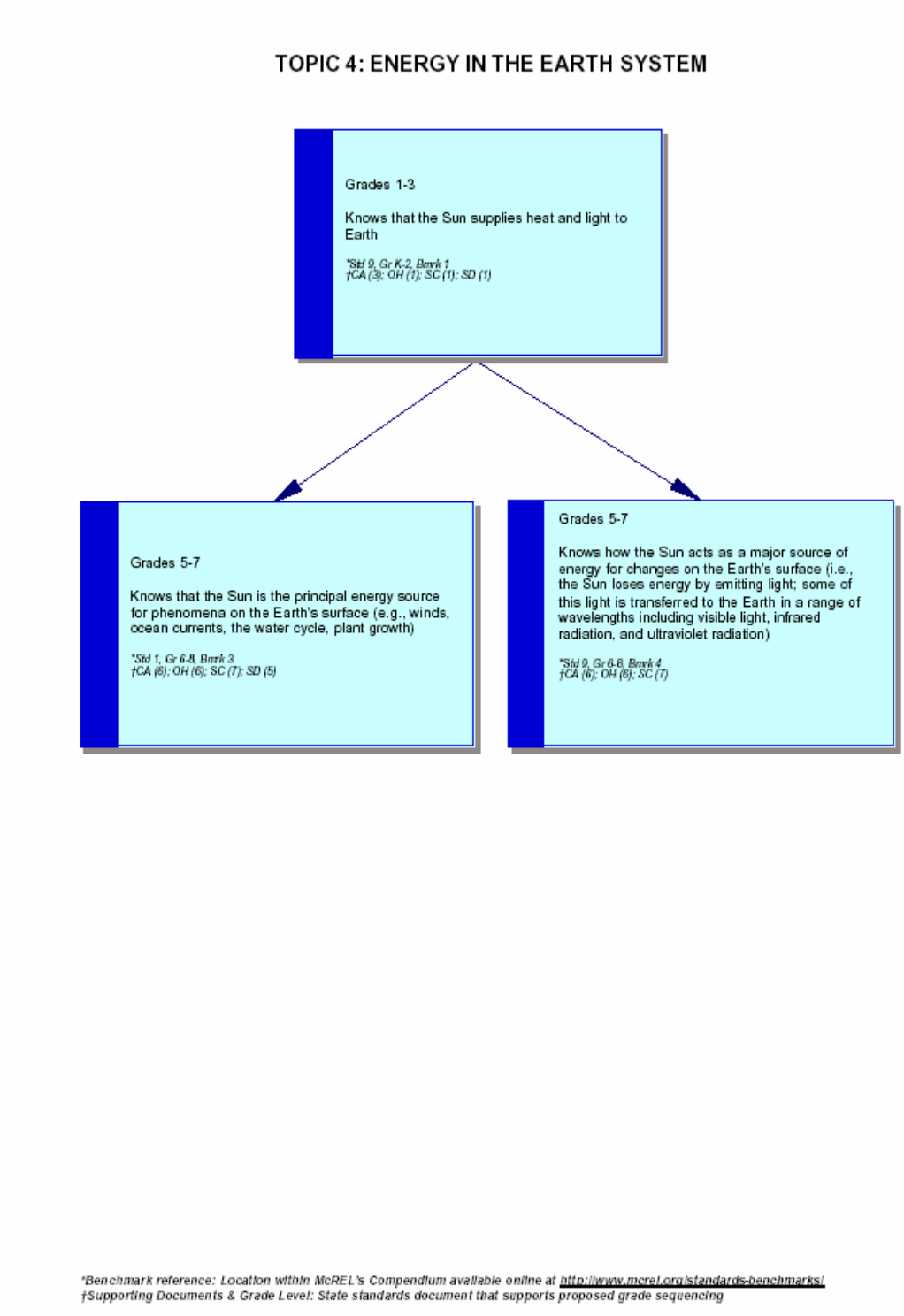


Figure B.3. Energy in the Earth System in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

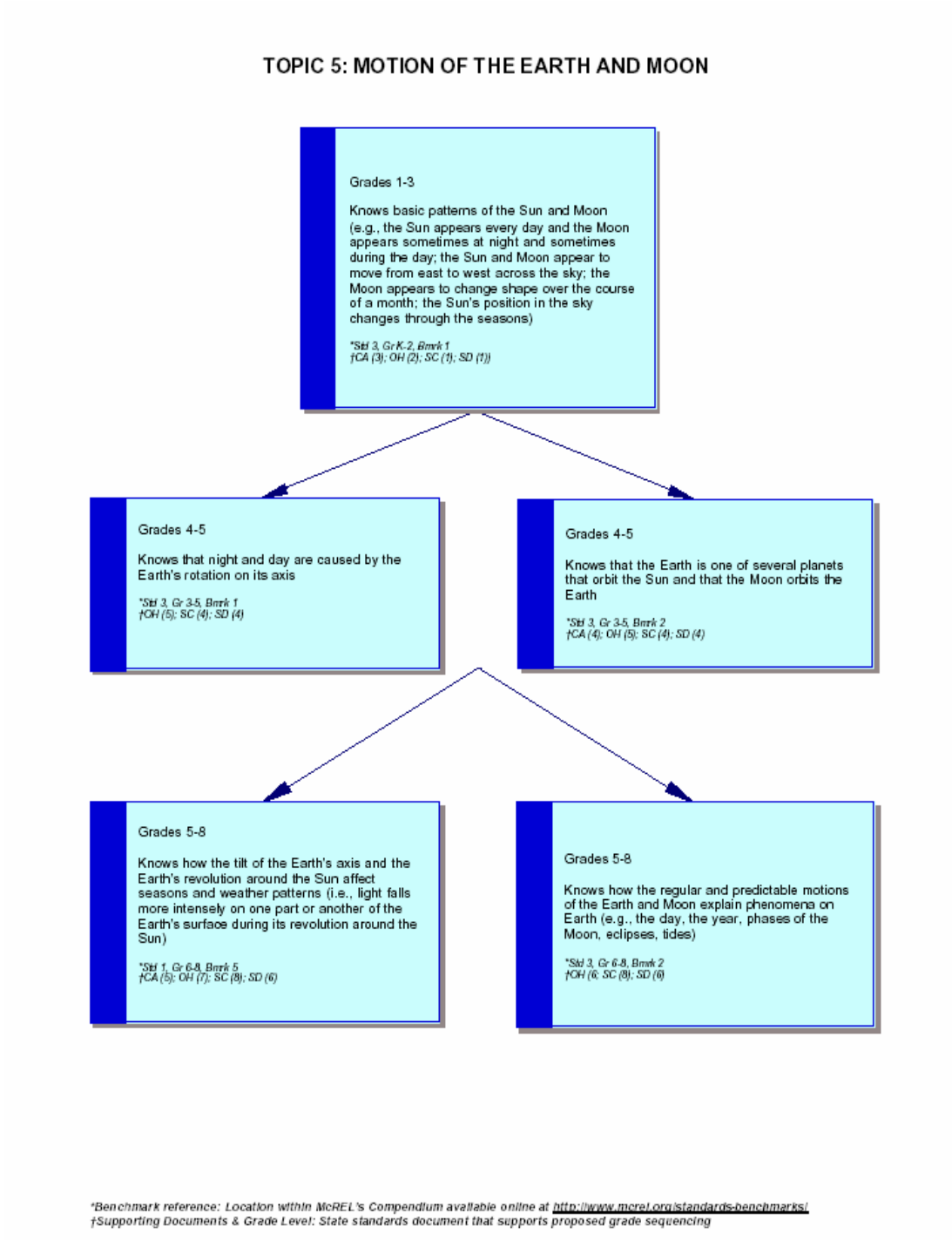


Figure B.4. Motion of the Earth and Moon in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

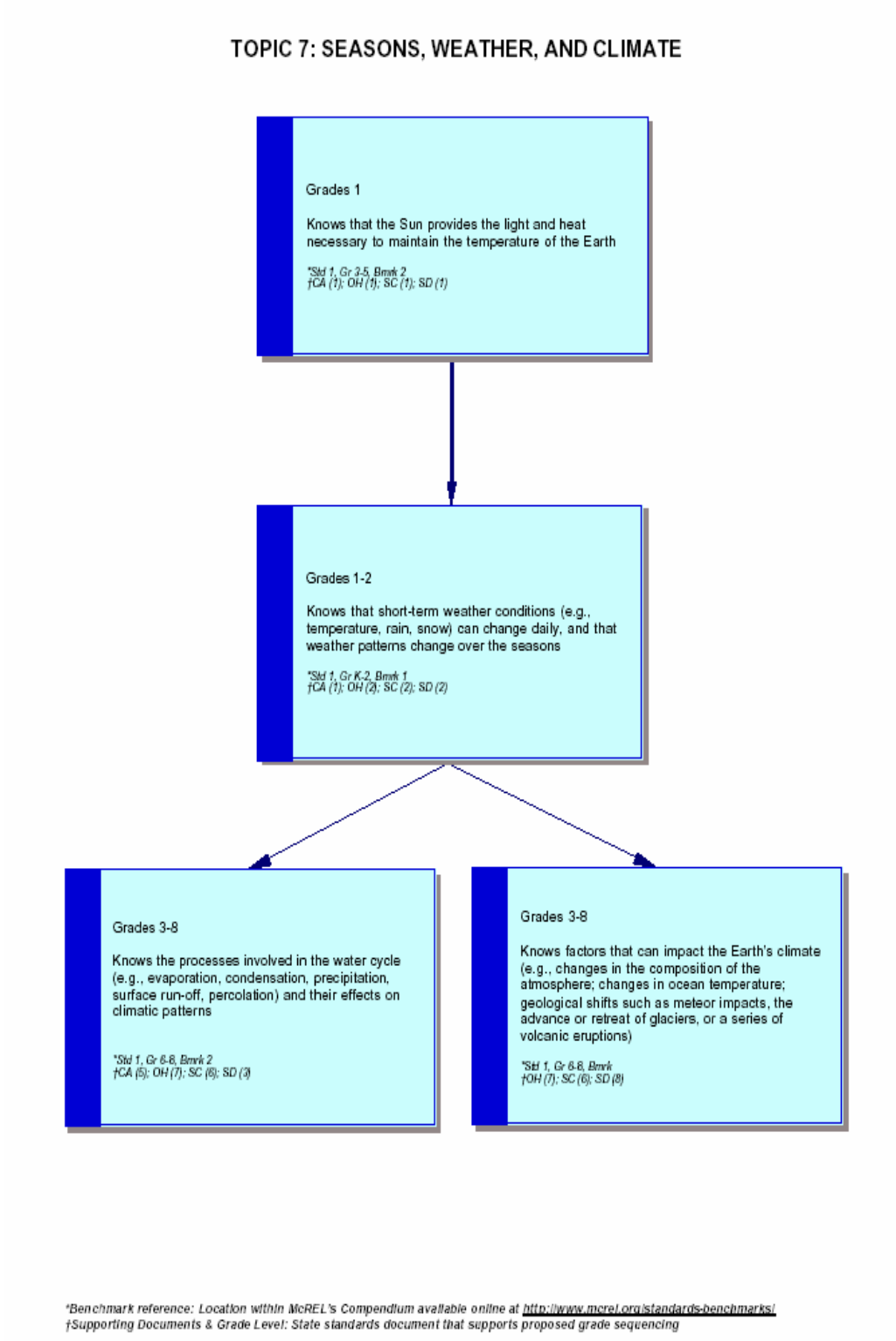


Figure B.5. Seasons, Weather, and Climate in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

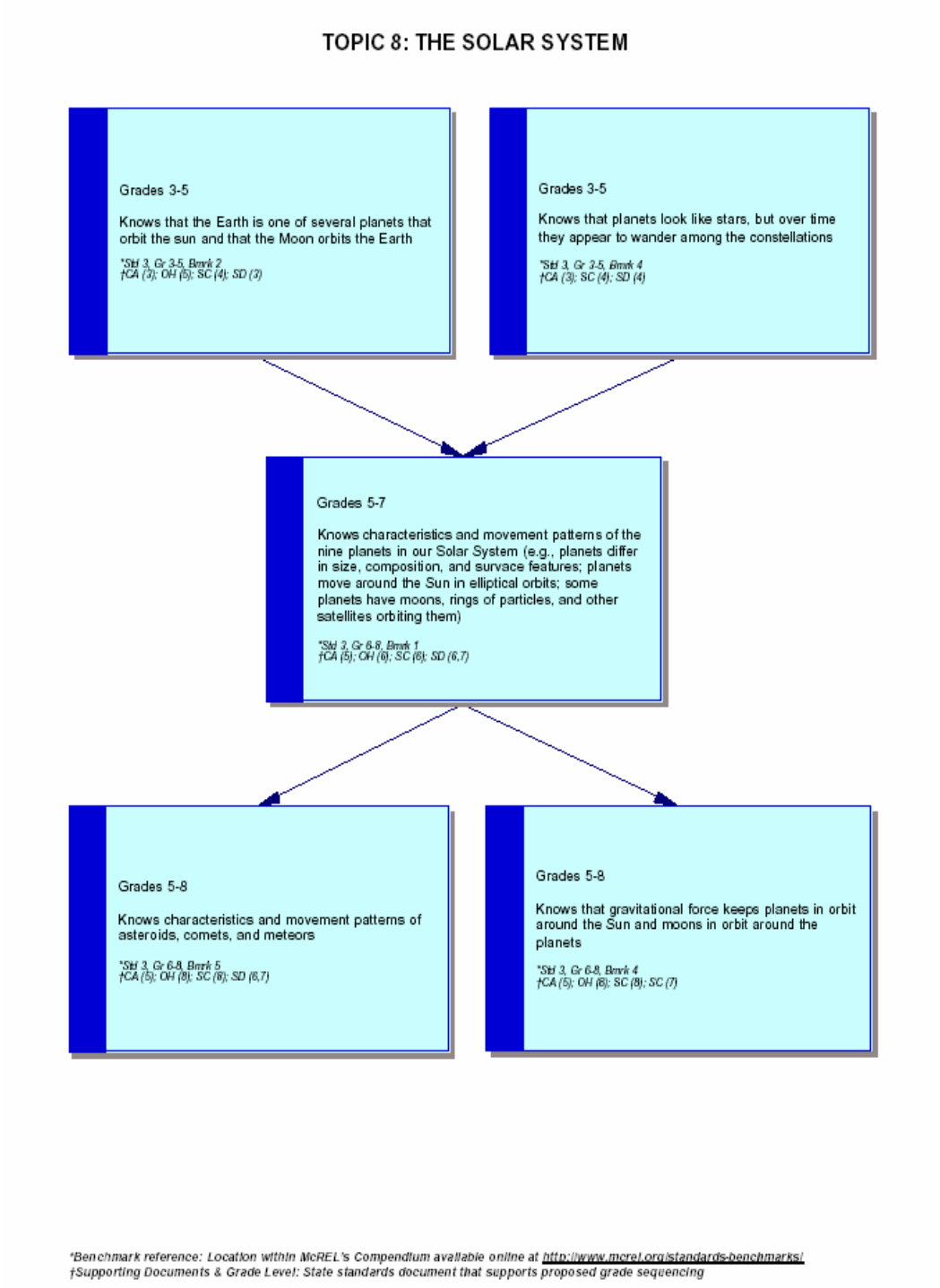


Figure B.6. The Solar System in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

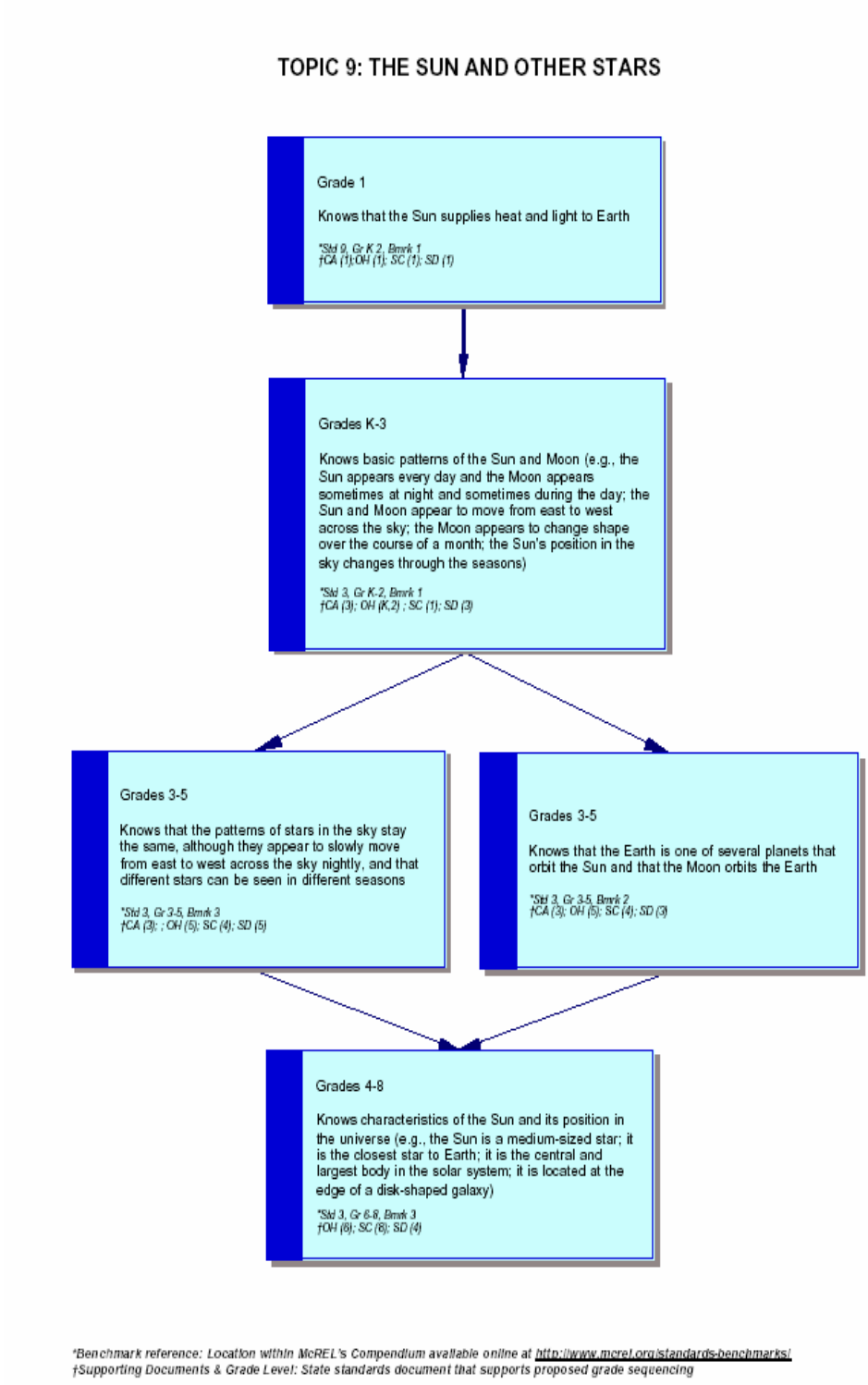


Figure B.7. The Sun and Other Stars in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

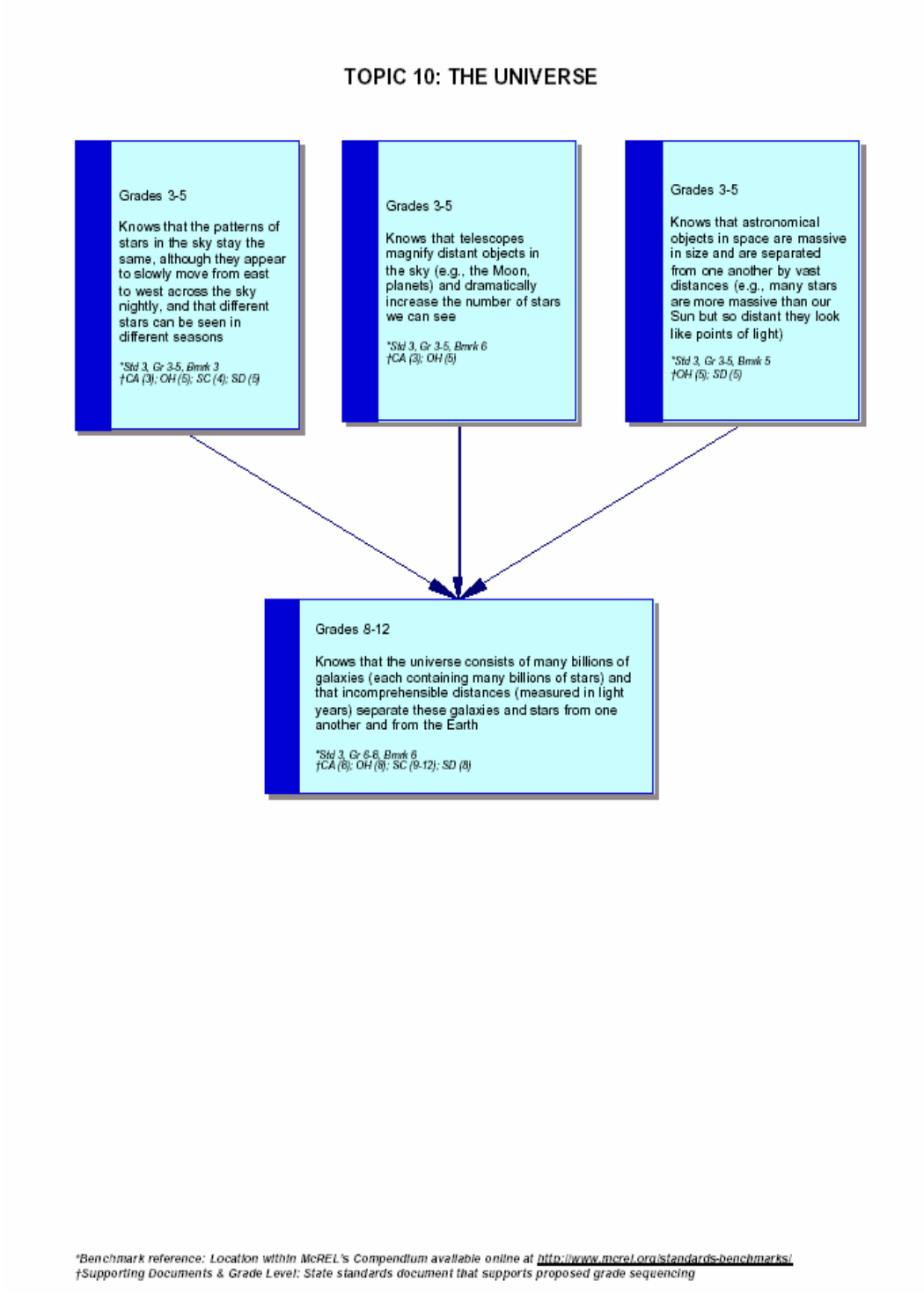


Figure B.8. The Universe in Sequenced Benchmarks for K-8 Prepared for the U.S Department of Education

APPENDIX C

BENCHMARKS OF ASTRONOMY TOPICS OF ELEMENTARY AND SECONDARY SCHOOLS IN AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

American Association for the Advancement of Science. (1993). *Benchmarks for Science Literacy*. Retrieved June 02, 2004 from www.project2061.org.

A. The Universe

Kindergarten through Grade 2

General Objectives:

- Noticing and describing objects in the sky (observational and qualitative point of views)
- Describing what the sky looks like at different times
- Observing the Moon and the change of its shape

By the end of the 2nd grade, students should know that

1. There are more stars in the sky than any one easily counts, but they are not scattered, and they are not all the same in brightness and color.
2. The Sun appears only in the daytime, but the Moon may appear sometimes at night and sometimes during the day. The Sun, the Moon, and the stars appear to move slowly across the sky.
3. The Moon appears a little different every day, but comes in sight the same again about every four-week.

Grades 3 through 5

General Objectives:

- Describing the appearance, size, and motion of planets
- Discriminating differences between stars and planets
- Observing the patterns of the fixed stars
- Observing the change of the positions of the planets against the pattern of stars
- Grasping the idea of composition and magnitude of the universe in the Earth-centered point of view
- Describing ideas about light and sight (e.g., large light source at a great distance appears as a small light source)
- Understanding the role of devices to see the sky objects

By the end of the 5th grade, students should know that

1. The patterns of stars in the sky remain the same, and different stars can be seen in different seasons.
2. Telescopes magnify distant objects in the sky, and the number of stars can be seen more with telescopes compared with observing with the unaided eye.
3. Planets change their positions.
4. The Earth is one of several planets that orbit the Sun, and the Moon orbits around the Earth.
5. Stars are like the Sun, some of them appears smaller and some of them larger, but they look like points of light since they are far away from the Earth.

Grades 6 through 8

General Objectives:

- Understanding general picture of the universe
- Constructing models about the size and distance of the solar system, and defining the size of the objects and distance between them in the solar system
- Using astronomical tools in order to estimate the positions of objects
- Using the light years to express astronomical distance between the objects in the sky

By the end of the 8th grade, students should know that

1. The Sun is a medium-sized star located near the edge of a disk-shaped galaxy of stars.
2. The universe involves many billions of galaxies, and each galaxy contains many billions of stars.
3. The Sun is many thousand of times closer to the Earth than any other star. Light from the Sun takes a few minutes to reach the Earth, but some distant galaxies are so far away that their light takes several billion years to reach the Earth.
4. Nine planets having different sizes, compositions, and surface features move around the Sun in nearly circular orbits. These planets have a great variety of moons. The Moon, satellites, and debris orbit around the Earth.
5. There are large numbers of chunks of rocks that orbit around the Sun.

Grades 9 through 12

General Objectives:

- Describing the role of the technology in exploring the universe
- Identifying the characteristics of the cosmos by physics, chemistry, insight from history, and mathematics
- Noticing the role of gravity in forming and maintaining planets, stars, and the solar system
- Expressing the relative distances using the concepts of the speed of the light

By the end of the 12th grade, students should know that

1. The stars differ from each other in size, temperature, and age, but they appear to be made up of the same elements that are found on the Earth, and they behave according to the same physical principles. Unlike the Sun, most stars are in systems of two or more stars orbiting around one another.
2. The universe is estimated to be over ten billion years old. According to the current theory, its entire contents expanded after exploding from a hot, dense, and chaotic mass. Stars condensed by the gravity out of the lightest elements' molecule clouds. During this period a great energy is released from the stars because of nuclear fusion. Eventually, some stars exploded, producing clouds of heavy elements. From these elements other stars and planets could later occur. The process of star formation and destruction always continues like this.
3. High technology is used to learn about the universe. Visual, radio, and x-ray telescopes are used to get information about the solar system and to collect the data about the sub-atomic particles that give information about the stars and the early history of the universe.

4. Mathematical models and computers are used in studying the data from many sources in order to form a scientific explanation of the universe.

B. The Earth

Kindergarten through Grade 2

By the end of the 2nd grade, students should know that

1. Some events in nature have a repeating pattern. The weather changes from day to day, but things such as temperature and rain (or snow) tend to be high, low, or medium in the same months every year.

Grades 3 through 5

By the end of the 5th grade, students should know that

1. Things on or near the Earth are pulled toward it by the Earth's gravity.
2. Like all planets and stars, the Earth is approximately spherical in shape. The rotation of the Earth on its axis is 24 hours, and this produces the night-and-day cycle. This turning of the planet makes it seem as though the Sun, the Moon, the planets, and the stars are orbiting the Earth every day.

Grades 6 through 8

By the end of the 8th grade, students should know that

1. The Earth is a relatively small planet, and it is the third planet from the Sun. The Solar System is the only system that is definitely

known to exist although other similar systems may be discovered in the universe.

2. The Earth is the only body in the solar system where life exists. The other planets' compositions and conditions are very different from the Earth's.
3. Everything on or anywhere near the Earth is pulled toward the Earth's center by gravitational force.
4. The Earth turns on an axis that is tilted while rotating around the Sun. During this rotation, sunlight falls more intensely on different parts of the Earth during the year, and this heat differences produces the Earth's seasons and weather patterns.
5. The Moon orbits around the Earth, and this allows what part of the Moon is lighted by the Sun and how much of that part can be seen from the Earth, and these changes in appearance create the phases of the Moon.

Grades 9 through 12

By the end of the 12^{th} grade, students should know that

1. Solar radiation heats the landmasses, oceans, and air. The rotation of the Earth influences the action of gravitational force on different regions, and this causes them to rise or fall, and such circulation produce winds and ocean currents.

APPENDIX D

NEW ZEALAND SCIENCE CURRICULUM STANDARDS RELATED WITH THE ASTRONOMY TOPICS

General achievement objectives

Science in the New Zealand Curriculum. (n.d). Retrieved October 16, 2004, from http://www.minedu.govt.nz/web/downloadable/d13525 v/1sci-nzc.pdf.

Students will use their developing scientific knowledge, skills and attitudes to:

1. Investigate the composition of the planet Earth and gain an understanding of the processes which shape it;
2. Investigate the geological history of the planet Earth and understand that our planet has long past and has undergone many changes;
3. Investigate and understand relationships between the planet Earth and its solar system, galaxy, and the universe;
4. Investigate how people's decisions and activities change the planet Earth's physical environment, and develop a responsibility for the guardianship of the planet Earth and its resources (New Zealand Science Curriculum, 1993, p. 106).

Level 1:

Achievement objectives:

Students can

1. Share their ideas about some easily observable features and patterns that occur in their physical environment and how some of these features may be protected, e.g., hills, beaches, rivers, cliffs, weather, seasons, and tides;

2. Suggest ways that their immediate physical environment was different in the past, e.g., the school playing fields, land use, river channels, road cuttings;
3. Share their ideas about objects in space and about very noticeable environmental patterns associated with these objects, e.g., the Moon, the Sun, stars, day and night, and seasons (New Zealand Science Curriculum, 1993, p. 108).

Level 2:

Achievement objectives:

Students can

1. Investigate easily observable physical features and patterns and consider how the features are affected by people, e.g., local landscapes, rocks, soils, tides, weather;
2. Understand that the Earth is very old and that animals and plants in past times were very different;
3. Use their ideas to investigate major objects in our solar system and very noticeable environmental patterns associated with these objects, e.g., the Moon, the Sun, stars, day and night, and seasons (New Zealand Science Curriculum, 1993, p. 110).

Level 3:

Achievement objectives:

Students can

1. Investigate the major features, including the water cycles, that characterize the Earth's water reserves, e.g., oceans, rivers, lakes, glaciers, ice-caps, snowfields, clouds;
2. Gather and present information about the origins and history of major natural features of the local landscape, e.g., volcanic cones, coastal cliffs, river flats, erosion scars, lakes, local soils;

3. Locate and use information obtained from space exploration to clarify, challenge, and extend their ideas about the general nature and behavior of the Earth, its Moon, and the other planets in our solar system, e.g., Moon missions, satellites, space stations;
4. Justify their personal involvement in a school- or class-initiated local environment project, e.g., a school tree planting project; paper, metal, or plastic recycling (New Zealand Science Curriculum, 1993, p. 112).

Level 4:

Achievement objectives:

Students can

1. Investigate the major factors and patterns associated with weather, and use given data to predict weather;
2. Collect and use evidence from landforms, rocks, fossils, and library research to describe the geological history of the local area;
3. (a) Use the simple technological devices to observe and describe our night sky, e.g., binoculars, simple star maps; (b) investigate and use models which explain the changing spatial relationships of the Earth, its Moon, and the Sun, and the way different cultures have used these patterns to describe and measure the time and position, e.g., phases of the Moon, eclipses, tides, seasons, sun clocks;
4. Investigate a local environmental issue and explain the reasons for the community's involvement, e.g., replanting of a cleared hillside, re-introduction of indigenous birds to a local area (New Zealand Science Curriculum, 1993, p. 114).

Level 5:

Achievement objectives:

Students can

1. Investigate and describe the process which change the Earth's surface over time at local and global levels, e.g., erosion, weathering, earthquakes, volcanoes, continental drift, plate tectonics;
2. (a) Use the simple technological devices, such as telescopes, and simple star maps, to observe and describe changing patterns in our night sky, e.g., position of the Moon, orientation of the Southern Cross; (b) use information obtained from technological devices, such as radio telescopes and satellites, to clarify, challenge, and extend their ideas about the general characteristics of some near and far space objects, e.g., structure, size, surface landscape, climate; the Sun and other stars, the Earth's Moon, planets, comets, meteors, clusters, galaxies; feasibility of life;
3. Researches a national environmental issues and explain the need for responsible and co-operative guardianship of New Zealand's environment, e.g., water reserves, water pollution, soil, erosion (New Zealand Science Curriculum, 1993, p. 116).

Level 6:

Achievement objectives:

Students can

1. (a) Investigate and classify some common minerals and rocks according to their easily observed properties and relate to their common use, e.g., calcite, feldspar, quartz, sulfur, magnetite; gemstones, building materials, road aggregates, use in industry; (b)

investigate how the tree major types of rocks are formed (igneous, metamorphic, and sedimentary) and describe how rock sequences provide evidence for past events through geological time;

2. Use information from a range of sources, including their own observation, to explain spatial relationships of the objects in the sky and challenge such spatial relationships present to space exploration, e.g., distance between and changing positions of the objects; theories about the origins of the Universe;
3. Report on an important natural resource in New Zealand, including its method of formation, location, and extraction, as appropriate, and any issues associated with its use, e.g., water, limestone, coal, natural gas (New Zealand Science Curriculum, 1993, p. 118).

Level 7:

Achievement objectives:

Students can

1. Use the range of techniques to infer what events may have shaped local and national landform features, e.g., field trips, geological maps, remote sensing;
2. Examine evidence from a variety of detectors to reach conclusions about the nature of stars and other celestial objects;
3. Survey and evaluate the literature relating to the Earth sciences' issue, e.g., open cast mining, oil spillage, disposal of nuclear waste (New Zealand Science Curriculum, 1993, p. 120).

Level 8:

Achievement objectives:

Students can

1. Carry out an extended investigation, involving a range of techniques, originating from their own interests into some aspect of, or issue related to, Planet Earth and Beyond;
2. Investigate and describe the sequence and characteristics of major events in the Earth's geological past;
3. Research and present a report on a current astronomical event or discovery (New Zealand Science Curriculum, 1993, p. 122).

APPENDIX E

ASTRONOMY STANDARDS IN ELEMENTARY SCIENCE PROGRAM OF THE STATE OF ALBERTA

Alberta's Kindergarten to Grade 12 Curriculum: Programs of Studies, http://www.learning.gov.ab.ca/k_12/curriculum/bySubject/default.asp#ecs, Last access date October 2004.

Table E.1. Elementary Science Program of the State of Alberta

Grade	Topic	Emphasize
1	A. Creating Color B. Seasonal Changes C. Building Things D. Senses E. Needs of Animals and Plans	Science Inquiry Science Inquiry Problem Solving Through Technology Science Inquiry Science Inquiry
2	A. Exploring Liquids B. Buoyancy and Boats C. Magnetism D. Hot and Cold Temperature E. Small Crawling and Flying Animals	Science Inquiry Science Inquiry Problem Solving Through Technology Science Inquiry Science Inquiry
3	A. Rocks and Minerals B. Building with a Variety of Materials C. Testing Materials and Design D. Hearing and Sound E. Animal Life Cycles	Science Inquiry Science Inquiry Problem Solving Through Technology Science Inquiry Science Inquiry
4	A. Waste and Our World B. Wheels and Levers C. Building Devices and Vehicles that Move D. Light and Shadows E. Plant Grow and Changes	Science Inquiry Science Inquiry Problem Solving Through Technology Science Inquiry Science Inquiry
5	A. Electricity and Magnetism B. Mechanisms Using Electricity C. Classroom Chemistry D. Weather Watch E. Wetland Ecosystems	Science Inquiry Science Inquiry Problem Solving Through Technology Science Inquiry Science Inquiry
6	A. Air and Aerodynamics B. Flight C. Sky Science D. Evidence and Investigation E. Trees and Forests	Science Inquiry Science Inquiry Problem Solving Through Technology Science Inquiry Science Inquiry

In the topic of “Seasonal Changes”, there are general and specific learning outcomes:

General Learner Expectation

Students will:

1-6 Describe seasonal changes, and interpret the effects of the seasonal changes on living things.

Specific Learner Expectation

Students will:

1) Describe the regular and predictable cycle of seasonal:
   - changes in sunlight
   - changes in weather
2) Identify and describe examples of plant and animal changes that occur on seasonal bases:
   - changes in form and appearance
   - changes in location of living things
   - changes in activity; e.g., students should recognize that many living things go into a dormant period during winter and survive under a blanket of snow as a seed, egg or hibernating animal
   - production of young on a seasonal basis
3) Identify human preparations for the seasonal change and identify activities that are done on seasonal basis.
4) Record observable seasonal changes over a period time (Science-Elementary, B.3, 1996, p.7).

In the “Sky Science” topic, also there are general and specific learning outcomes;

General Learner Expectation

Students will:

6-7 Observe, describe and interpret the movement of objects in the sky; and identify pattern and order in these movements.

Specific Learner Expectation

Students will:

1) Recognize that the Sun and stars emit the light by which they are seen and that most other bodies in space, including the Earth's Moon, planets and their moons, comets, and asteroids, are seen by reflected light.
2) Describe the location and movement of individual star and group of stars (constellations) as they move through the night sky.
3) Recognize that the apparent movement of objects in the night sky is regular and predictable, and explain how this apparent movement is related with the Earth's rotation.
4) Understand that the Sun should never be viewed directly, nor by use of simple telescope or filters, and that safe viewing requires appropriate methods and safety precautions.
5) Construct and use a device for plotting the apparent movement of the Sun over the course of day; e.g., construct and use a sundial or shadow stick.
6) Describe seasonal changes in the length of the day and light and in the angle of the Sun above the horizon.
7) Recognize that the Moon's phases are regular predictable, and describe the cycle of its phases.
8) Illustrate the phases of the Moon in drawings and by using improving models. An improvised model might involve such things as a table lamp and a sponge ball.
9) Recognize that the other eight known planets, which revolve around the Sun, have characteristics and surface conditions that are different from the Earth; and identify examples of those differences.
10) Recognize that not only the Earth, but also other planets, have moons; and identify examples of similarities and differences in the characteristics of those moons.

11) Identify technologies and procedures by which knowledge, about planets and other objects in the sky, has been gathering.
12) Understand that Earth, the Sun and the Moon are part of a solar system that occupies only a tiny part of the known universe (Science-Elementary, B.32, 1996, p.36).

APPENDIX F

ASTRONOMY STANDARDS IN JUNIOR HIGH SCHOOL SCIENCE PROGRAM OF THE STATE OF ALBERTA

Alberta's Kindergarten to Grade 12 Curriculum: Programs of Studies, http://www.learning.gov.ab.ca/k_12/curriculum/bySubject/default.asp#ecs, Last access date October 2004.

Table F.1. Junior High School Science Program of the State of Alberta

Grade 7	Grade 8	Grade 9
Interactions and Ecosystems	Mix and Flow of Matter	Biological Diversity
Plants for Food and Fibre	Cells and Systems	Matter and Chemical Change
Heat and Temperature	Light and Optical Systems	Environmental Chemistry
Structures and Forces	Mechanical Systems	Electrical Principles and Technologies
Planet Earth	Freshwater and Saltwater Systems	Space Exploration

Overview

This unit allows students to "examine how science and technology interact and to learn how one process augments the other" (Alberta Learning, 2003, p. 70). This unit bases on ideas introduced in Grade 6 (See Appendix E).

Focusing Questions

"How humans attained a presence in space? What technologies have been developed and on what scientific ideas are they based? How has the development of these technologies contributed to exploration, use and understanding of space and to benefits to the Earth?" (Alberta Learning, 2003, p. 70).

Key Concepts

- technologies for space exploration and observation
- reference frame for describing position and motion in space
- satellites and orbits
- distribution of matter through space
- composition and characteristics of bodies in space
- life-support technologies
- communication technologies

Outcomes

Students will:

1. Investigate and describe the ways that humans understanding the Earth and space has dependent on technological development

- Identify different perspective on the nature of the Earth and space, based on culture and science (e.g., describe cosmologies based on the

Earth-Centered universe [detailed knowledge of epicycles is not required]; describe aboriginal view of space and those of other cultures; describe the role observation in guiding scientific understanding of space).

- Investigate and illustrate the contribution of technological advance-including optical telescope, spectral analysis, and space travel-to scientific understanding of space.
- Describe, in general terms, the distribution of matter in space (e.g., stars, stars systems, galaxies, nebulae)
- Identifies evidence for, and describe characteristics of, bodies that make up the solar system; and compare their characteristics with those of the Earth.
- Describe and apply techniques foe determining the position and motion of objects in space, including;

    - constructing and interpreting drawings and physical models that illustrate the motion of objects in space (e.g., represent the orbit of comets around the Sun, using a looped-string model)
    - describing the techniques used to estimate distance of objects in space and determine their motion
    - describing the position of objects in space, using angular coordinates (e.g., describe the location of a spot on a wall, by identifying its angle of elevation and its bearing or azimuth; describe the location of the Sun and other stars using altitude-azimuth coordinates, also referred to as horizon coordinates or local coordinates) [A description of star positions based on right ascension and declination is not required] [Prerequisite Skills: Grade 7 Mathematics, Shape and Space and Grade 9 Mathematics, Shape and Space]

- Investigate the predictions about the motion, alignment and collision of bodies in space (e.g., investigate predictions about eclipses; identify uncertainties in predicting and tracking meteor showers)

2. Identify problems in developing technologies for space exploration, describe technologies developed for life in space, and explain scientific principles involved
3. Describe and interpret the science of optical and radio telescopes, space probes and removed sensing technologies
4. Identify issues and opportunities arising from the application of space technology, identify alternatives involved, and analyze implications (Alberta Learning, 2003, p. 70-71).

APPENDIX G

NAME OF THE ELEMENTARY SCHOOLS IN THE STUDY

1. Kutalmışbey İlköğretim Okulu-ALTINDAĞ
2. Tandoğan İlköğretim Okulu-ALTINDAĞ
3. Ulus İlk Meclis İlköğretim Okulu-ALTINDAĞ
4. Evliya Çelebi İlköğretim Okulu-ALTINDAĞ
5. Çalışkanlar İlköğretim Okulu-ALTINDAĞ
6. Pakize Erdoğu İlköğretim Okulu-ÇANKAYA
7. Halide Edip Adıvar İlköğretim Okulu-ÇANKAYA
8. Milli Eğitim Vakfı İlköğretim Okulu-ÇANKAYA
9. Mithatpaşa İlköğretim Okulu-ÇANKAYA
10. Talatpaşa İlköğretim Okulu-ÇANKAYA
11. Arjantin İlköğretim Okulu-ÇANKAYA
12. Nurçin Sayan İlköğretim Okulu-ÇANKAYA
13. Sancaktepe İlköğretim Okulu-KEÇİÖREN
14. Nebahat Taşkın İlköğretim Okulu-KEÇİÖREN
15. Toygar Börekçi İlköğretim Okulu-KEÇİÖREN
16. Pursaklar İlköğretim Okulu-KEÇİÖREN
17. Kamil Ocak İlköğretim Okulu-KEÇİÖREN
18. Paşalı Necati İlköğretim Okulu-KEÇİÖREN
19. Çağlar İlköğretim Okulu-KEÇİÖREN
20. İbrahim Akoğlu İlköğretim Okulu-KEÇİÖREN
21. Yenimutlu İlköğretim Okulu-MAMAK
22. Yeşiltepe İlköğretim Okulu-MAMAK
23. 19 Mayıs İlköğretim Okulu-MAMAK
24. Gülveren İlköğretim Okulu-MAMAK
25. Ahmet Hızal İlköğretim Okulu-MAMAK
26. Gazneliler İlköğretim Okulu-SİNCAN
27. Sühendan Kürklü İlköğretim Okulu-SİNCAN
28. Atatürk İlköğretim Okulu-SİNCAN

29. Melikşah İlköğretim Okulu-SİNCAN
30. Mehmet Akif Ersoy İlköğretim Okulu-SİNCAN
31. Yahyalar İlköğretim Okulu-YENİMAHALLE
32. Kayalar İlköğretim Okulu-YENİMAHALLE
33. Anadolu İlköğretim Okulu-YENİMAHALLE
34. Fatih İlköğretim Okulu-YENİMAHALLE
35. Şüküfe Nihal İlköğretim Okulu-YENİMAHALLE

APPENDIX H

NAME OF THE SECONDARY SCHOOLS IN THE STUDY

1. Uluğbey Lisesi-ALTINDAĞ
2. Yıldırım Beyazıt Anadolu Lisesi-ALTINDAĞ
3. Kılıçarslan Lisesi-ÇANKAYA
4. Ankara Anıttepe Lisesi-ÇANKAYA
5. İncesu Anadolu Lisesi-ÇANKAYA
6. Çankaya Anadolu Lisesi-ÇANKAYA
7. Mehmet Emin Resulzade Anadolu Lisesi-ÇANKAYA
8. Etlik Lisesi-KEÇİÖREN
9. Keçiören Lisesi-KEÇİÖREN
10. Abdullah-Mürşide Özünenek Cumhuriyet 75. Yıl-KEÇİÖREN
11. Farabi Lisesi-KEÇİÖREN
12. Ege Lisesi-MAMAK
13. Niğbolu Lisesi-MAMAK
14. Ali Naili Erdem Lisesi-MAMAK
15. Sincan Lisesi-SİNCAN
16. Ibni-Sina Lisesi-SİNCAN
17. 75.Yıl Lisesi-YENİMAHALLE
18. Prof. Dr. Şevket Raşit Hatipoğlu Lisesi-YENİMAHALLE
19. Gazi Anadolu Lisesi-YENİMAHALLE
20. Nermin Mehmet Çekiç Anadolu Lisesi-YENİMAHALLE

APPENDIX I

INTERVIEW PROTOCOL FOR ACADEMICIANS AND ASTRONOMY LECTURER

MÜLAKAT PROTOKOLÜ

Konu: Türkiye'de İlköğretim ve Ortaöğretim Okulları için Astronomi Öğretim Program Geliştirilmesi için İhtiyaç Analizi Yapılması

Mülakat Tarihi / Süre:

Mülakatın Yapıldığı Kişi:

Mülakat Yeri:

Mülakatın Amacı: Öğretmen ve öğrenci görüşlerini almak için geliştirilecek Astronomi anketleri için eğitimci, akademisyen ve uzman görüşlerinden yararlanmak.

SORULAR:

1. Astronomi konuları Anaokulu–3, 4–5, 6–8 ve 9–11 sınıf aralıklarında okutulmalı mıdır? Açıklayınız.

2. Astronomi programı hazırlanırken ne tür amaçlar gözetilmelidir?

3. Astronomi programı ile ilgili ihtiyaç analizine gerek var mıdır? Buna gerek var ise bu analiz yapılırken dikkate edilmesi gerekenler nelerdir?

4. Astronomi programının hazırlanmasında özellikle dikkat edilmesi gereken belli başlı noktalar neler olmalıdır?

5. Astronomi derslerini verebilecek öğreticilerin mevcut durumda yeterli bilgiye sahip olduklarını söyleyebilir miyiz?

6. Yetiştirilecek öğreticilerin eğitiminde nasıl bir yöntem izlenmelidir?

7. Astronomi ile ilgili hazırlanacak bir program ulusal ve toplumsal anlamda ne tür faydalar sağlayacaktır?

APPENDIX J

INITIAL VERSION OF "A QUESTIONNAIRE TO DETERMINE THE TEACHERS' OPINIONS ABOUT THE DEVELOPMENT OF THE ASTRONOMY PROGRAM"

ASTRONOMİ ÖĞRETİM PROGRAMI GELİŞTİRİLMESİ HAKKINDA ÖGRETMEN GÖRÜŞLERİNİ BELİRLEME ANKETİ

Bu anket Sınıf Öğretmeni, Fen Bilgisi, Fizik Öğretmenleri ve Astronomi ile ilgili uzmanlardan, geliştirilmesi düşünülen Astronomi Öğretim Programı hakkında düşüncülerini almak ve program ile ilgili genel bir çerçeve yaratmak amacıyla hazırlanmıştır.

Amaçlar:

Anketteki maddeler aşağıdaki ölçütler dikkate alınarak belirlenmiştir:

1) Amaçlara ilişkin ölçütler
   a) Bilimsel bilgi
   b) Bilimsel tutum ve değer
   c) Bilişsel süreç ve beceriler
2) İçeriğe ilişkin ölçütler
3) Öğretme-öğrenme süreçlerine ilişkin ölçütler
4) Değerlendirmeye ilişkin ölçütler
5) Öğretim ortamına ve olanaklara ilişkin ölçütler

Yönerge: Aşağıdaki soru Astronomi konularının belirtilen sınıf aralıklarında nasıl okutulması gerektiğine dair görüş almak amacı ile sorulmuştur.

Astronomi konuları Anaokulu–3, 4–5, 6–8 ve 9–11 sınıf aralıklarında nasıl okutulmalıdır? Aşağıda verilen tabloda size uygun olan kutucuğu [**X**] işareti koyarak işaretleyiniz ve gerekçenizi belirtiniz.

SINIF	**Bir ders altında okutulmalıdır**	**Ayrı bir ders olarak okutulmalıdır**	**Fark etmez**	**GEREKÇENİZ**
A-3				
4-5				
6-8				
9-11				

Yönerge: Aşağıdaki tabloda ilk sütunda, astronomi ile ilgili konular sıralanmıştır. İkinci sütunda bu konuların gereklilik düzeyini belirlemek amacı ile beşli bir derecelendirme verilmiştir. Bu derecelendirme bu konuyu "Gereksiz" buluyorum ile "Çok Gerekli" buluyorum aralığındadır. Üçüncü sütun, ilk sütunda verilen her bir konunun verilebilecek uygun sınıf seviyelerini belirlemek amacı ile ankete katılan katılımcının değerlendirmesini almak amacı ile konmuştur. Dördüncü ve son sütun ise katılımcıların konular için uygun gördükleri sınıf seviyelerinin gerekçelerini belirtmeleri için konmuştur.

Aşağıdaki tabloda verilen konular, bir astronomi öğretim programı için belirlenmiş konulardır, bu konuların öğretim programda öğretilmesinin gerekli olup olmadığını aşağıda verilen derecelerden uygun gördüğünüzü seçerek değerlendirme sütununda işaretleyeniz. Konuları verilebilecek uygun sınıf seviyelerine göre düzenlemenizi istersek, hangi konunun hangi sınıf seviyesinde verilmesini isterdiniz? Gerekçeniz nedir?

Konuların gereklilik düzeyini belirlemek amacı ile kullanılacak derecelendirme ölçeği:

[0]……..Gereksiz

[1]……..Çok Gerekli Değil
[2]……..Ne Gerekli Ne Gereksiz
[3]……..Gerekli
[4]……..Çok Gerekli

Uygun sınıf seviyelerini belirtmek amacı ile kullanılacak ölçek:

[1] ……[Anaokulu-3]
[2]....…….[4-5]
[3]....…….[6-8]

KONULAR	DEĞERLENDİRME	SINIF	GEREKÇENİZ
1. Gökyüzündeki nesnelerin yerleri, hareketleri ve özellikleri	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
2. Güneş, ay, yıldızlar, bulutlar, uçan canlılar ve nesnelerin davranışları	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
3. Güneşin Dünya üzerindeki etkisi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
4. Gökyüzünde hareket eden nesnelerin yörünge hareketleri	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
5. Dünyanın Güneş sistemindeki yeri	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
6. Güneş sistemindeki gezegenleri bu gezegenlerin uydularını, asteroit ve kuyrukluyıldız gibi güneş sisteminde bulunan küçük cisimlerin özellikleri	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
7. Güneşin özellikleri ve oluşturduğu sistem içindeki önemi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
8. Güneş sistemindeki nesnelerin düzenli ve öngörülebilir hareketleri	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
9. Güneş sistemindeki gezegenlerin hareketlerinin sonuçları	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
10. Ayın safhaları ve güneş ve ay tutulmaları	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
11. Bir kuvvet olarak kütle çekimi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	

12. Güneş sisteminde kütle çekim kuvvetinin rolü	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
13. Dünya üzerinde çekim kuvvetinin rolü	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
14. Gel-git olayı ve çekim kuvvetinin bu olaydaki rolü	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
15. Enerji kaynağı olarak güneşin önemi ve dünyadaki ekolojik sisteme olan etkisi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
16. Dünyanın kendi ve güneş etrafında dönüşü gece-gündüzün ve yılın oluşumu, gün uzunluğu kavramı, dünya ekseninin eğikliği ve bunun sonuçları	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
17. Mevsimlerin oluşumu	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
18. Nebula gaz bulutu ve evrenin oluşumu	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
19. Dünyanın evrimi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
20. Evrenin başlangıcı	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
21. Büyük patlama teorisi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
22. Evrenin genişlemesi ile ilgili teoriler	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
23. Trilyonlarca yıldız, milyonlarca galaksinin doğuşu ve evrimi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
24. Evrendeki görünür kütle kavramı	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	

25. Yıldız enerjisi ve yıldızların yapısı	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
26. Zaman ve Takvim bilgisi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
27. Astronomi Aletleri	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
28. Rölativite	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
29. Astronomi Tarihi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
30. Güneş Sistemi	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
31. Uzay Çalışmaları	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	
32. Evrende Yaşam	[0] [1] [2] [3] [4]	[1] [2] [3] [4]	

Yönerge: Bir önceki soruda verilen tabloda olmayan, fakat olması gerektiğine inandığınız konular varsa, bu konuların adını, konması gereken sınıf seviyesini ve neden konulması gerektiğini aşağıdaki tabloya lütfen yazınız.

KONU	SINIF	GEREKÇENİZ
	[1] [2] [3] [4]	
	[1] [2] [3] [4]	
	[1] [2] [3] [4]	
	[1] [2] [3] [4]	
	[1] [2] [3] [4]	

	[1] [2] [3] [4]	
	[1] [2] [3] [4]	
	[1] [2] [3] [4]	

∗Hazırlanacak astronomi programında, öğrencilerin öğrenme sürecini sorunsuz tamamlamak ve oluşabilecek anlama zorluklarını ve kavram yanılgılarını engellemek için genel olarak alınması gereken önlemler neler olmalıdır? Birden fazla işaretleyebilirsiniz.

a) Konuları bütünlük içinde vermek
b) Günlük hayatla bağlantı kurmak
c) Konuları basit formüllerle vermek
d) Konuları somut kavramlarla vermek
e) Basit ve anlaşılır deneyler hazırlamak
f) Önbilgi eksikliklerini ve kavram yanılgılarını ortaya çıkarmak
g) Konulara yeterli süre vermek
h) Diğer:…….

∗Astronomi dersini aşağıdaki hangi yöntem veya yöntemlerle öğretmek istersiniz? Açıklayınız. Birden fazla işaretleyebilirsiniz.

a) Geleneksel öğretim yöntemi kullanarak (öğretmen merkezli)
b) Deney ve gözlem yaptırarak
c) Proje çalışması yaparak
d) Araştırma ve tartışma ortamı kurarak
e) Grup çalışması yaptırarak
f) Sınıf içi oyunlar oynatarak
g) Öğrencilerin ilgi-bilgi ve seviyelerine göre hazırlanmış aktiviteler hazırlayarak
h) Bilgisayar destekli yöntemler geliştirerek
i) Diğer:…….....

∗Astronomi dersi içinde neler öğretmek istersiniz? Açıklayınız.

a) Astronomi ile ilgili yapılmış/yapılacak proje çalışmalarını (örneğin; Mars'a yolculuk projesi)
b) Güncel gelişmeleri içeren konuları (örneğin; yeni bir gezegenin bulunması)
c) Gündelik yaşamla ilişkili konuları (örneğin; güneş-ay tutulması)
d) Astronomi tarihi (örneğin; astronominin gelişim süreci)
e) Diğer:……..

∗Astronomi dersinde nasıl bir değerlendirme yöntemi kullanılmalıdır?

a) Yazılı ve sözlü sonuçlarına göre
b) Proje çalışmaları sonuçlarına göre
c) Dönem içi gözlemlere göre
d) Performansa dayalı
e) İnceleme, gözlem ve deney yapma becerilerine göre
f) Grup çalışmalarına göre
g) Diğer:……..

∗Astronomi öğretim programı ile öğrencilerin bilimsel tutum ve değerlerinde ne tür değişimler sağlanabilir?

…….
……..
……
……

∗Astronomi öğretim programı öğrencilerin bilişsel süreçleri ve becerilerinde ne tür gelişmeler sağlayabilir?

…….
…….
……
…….

∗Astronomi öğretim programı ile öğrencilere sınıf içi, okul, eğitim ortamı ve yaşadığı çevre açısından ne tür olanaklar sağlanabilir?

……
……

…….....
.....

∗Sosyal Bilgisi ve Fen Bilgisi dersleri altında verilen astronomi eğitiminde sorun olarak gördüğünüz noktalar nelerdir?

……
……
…….....
.....

∗Şu anki programı ve bu programın uygulanmasındaki sorunları dikkate aldığımızda yeni Astronomi programın ne tür eksiklikleri giderilmiş olarak beklersiniz?

……
……
……
……

∗Son olarak, hazırlanacak bir astronomi öğretim programı için yukarıda bahsedilmeyen görüş ve önerileriniz neler olabilir?

……
……
……
……

Katkılarınızdan dolayı teşekkür ederim.

APPENDIX K

INITIAL VERSION OF "A QUESTIONNAIRE TO DETERMINE THE ELEMENTARY STUDENTS' OPINIONS ABOUT THE DEVELOPMENT OF THE ASTRONOMY PROGRAM"

ASTRONOMİ ÖĞRETİM PROGRAMI GELİŞTİRİLMESİ HAKKINDA İLKÖĞRETİM ÖĞRENCİLERİNİN GÖRÜŞLERİNİ BELİRLEME ANKETİ

Bu anket, İlköğretim ve Ortaöğretim öğrencilerine uygulanarak, geliştirilmesi düşünülen Astronomi Öğretim Programı hakkında onların düşüncelerini almak ve program ile ilgili genel bir çerçeve yaratmak amacıyla hazırlanmıştır.

Amaçlar:

Anketteki maddeler aşağıdaki ölçütler dikkate alınarak belirlenmiştir:

1) Amaçlara ilişkin ölçütler
    a. Bilimsel bilgi (3. , 4. sorular)
    b. Bilimsel tutum ve değer (8. , 12. sorular)
    c. Bilişsel süreç ve beceriler (8. ,9. sorular)
2) İçeriğe ilişkin ölçütler (2. , 3. , 4. sorular)
3) Öğretme-öğrenme süreçlerine ilişkin ölçütler (5., 6. sorular)
4) Değerlendirmeye ilişkin ölçütler (7. soru)
5) Öğretim ortamına ve olanaklara ilişkin ölçütler (10. ve 11. sorular)

Açıklama:

Aşağıdaki sorular hazırlanacak bir astronomi dersi için görüşlerinizi almak amacıyla sorulmuştur.Lütfen, soruları dikkatli okuyup cevaplandırınız.

Yönerge 1:

Aşağıdaki cinsiyet ile ilgili size uygun olanı seçeneği yuvarlak içine alınız. Ayrıca sınıfınız, anne ve babanızın eğitim durumu ile ilgili bilgileri yazınız.

Cinsiyetiniz:

[K] Kız [E] Erkek

Sınıfınız:……

Annenizin eğitim durumu:.....

Babanızın eğitim durumu:.....

Yönerge 2:

Astronomi konularını Sosyal Bilgisi veya Fen Bilgisi dersi içinde mi yoksa ayrı bir ders olarak mı öğrenmek istersiniz? Aşağıda verilen tabloda size uygun olan kutucuğa çarpı [**X**] işareti koyunuz ve nedenini yazınız.

Bir ders altında okumak istiyorum (Sosyal Bilgisi, Fen Bilgisi)	**Ayrı bir ders olarak okumak istiyorum**	**Fark etmez**	**GEREKÇENİZ**

Yönerge 3:

Aşağıda verilmiş olan Astronomi konularından öğrenmek istediğinizin yanındaki tercih bölümüne **Artı (+)** işareti, öğrenmek istemediğinizin yanındaki tercih bölümüne de **Eksi (-)** işareti koyunuz ve yaptığınız tercihin nedenlerini kısaca yazınız.

KONULAR	TERCİH	GEREKÇENİZ
1) Işık bilgisi ve Gölge (ışığın davranışı, yarı gölge ve tam gölge oluşumu)		
2) Güneş-Dünya ve Ay arasındaki ilişkiler ve bu ilişkilerin sonuçları (Güneş ve Ay tutulmaları)		
3) Güneşin özellikleri, Güneş sistemi ve bu sistemdeki cisimlerin hareketleri (güneş sistemindeki gezegenlerin ve nesnelerin yörünge hareketleri)		
4) Dünyanın ve diğer gezegenlerin Güneş sistemindeki yeri ve hareketi		
5) Dünyanın kendi ve Güneş sistemindeki hareketi ve bu hareketin sonuçları (gece-gündüzün, yılın ve mevsimlerin oluşumu)		
6) Kütle çekim kuvveti ve bu kuvvetin cisimler üzerindeki etkisi (yerçekimi ve gel-git olayı)		
7) Güneşin Dünyadaki yaşam üzerindeki etkisi (enerji kaynağı olarak güneşin önemi ve dünyadaki ekolojik sisteme olan etkisi)		
8) Nebula gaz bulutu ve evrenin oluşumu (evrenin başlangıcı, büyük patlama teorisi ve evrenin genişlemesiyle ilgili teoriler)		
9) Yıldız ve galaksilerin doğuşu, yapısı ve evrimi		
10) Evrenin kütlesi (görünür kütle kavramı)		
11) Zaman ve Takvim bilgisi		
12) Burçlar		
13) Astronomi aletleri ve kullanıldığı alanlar		
14) Astronomi tarihi		

15) Uzay çalışmaları		
16) Evrende yaşam		

Yönerge 4:

Bir önceki soruda verilen tabloda olmayan, ama öğrenmek istediğiniz başka astronomi konuları varsa

bu konuların adını ve neden konulması gerektiğini yazınız.

ASTRONOMİ KONUSU	GEREKÇENİZ

5. Okulunuzda bir astronomi dersinin olduğunu varsayın bu dersi iyi öğrenmek için nelerin yapılmasını istersiniz? En çok istediğinizden, en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız. (Örnek: "En çok istediğinizin yanına (1), daha az istediğinizin yanına (2) şeklinde rakam vererek sıralayınız)

a) Konuların bütünlük içinde verilmesini
b) Günlük hayatla bağlantı kurulmasını
c) Konuları basit formüllerle verilmesini
d) Konuların anlaşılır bilgilerle verilmesini
e) Basit ve anlaşılır deneyler hazırlanmasını
f) Önbilgi eksikliklerinin ve kavram yanılgılarının ortaya çıkarılmasını
g) Konulara yeterli süre verilmesini
h) Diğer:……..

6. Astronomi dersini aşağıdaki hangi yöntemlerle öğrenmek istersiniz? Açıklayınız. En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Bilginin sadece öğretmen tarafından verildiği bir yöntem ile.Çünkü;.....
b) Deney ve gözlem ile. Çünkü;.....
c) Proje çalışması ile. Çünkü;.....
d) Araştırma ve tartışma ortamı ile. Çünkü;.....
e) Grup çalışması ile. Çünkü;.....
f) Sınıf içi oyunlar ile. Çünkü;.....
g) İlgi alanımız ve bilgi seviyemize göre hazırlanmış etkinlikler ile. Çünkü;.....
h) Bilgisayar destekli yöntemler ile. Çünkü;.....
i) Diğer:……...

7. Astronomi dersinde aşağıdakilerden hangilerinin dikkate alınarak not verilmesini istersiniz?En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Yazılı ve sözlü sınav sonuçlarına göre
b) Proje çalışmaları sonuçlarına göre
c) Dönem boyunca sınıf içi gözlemlere göre

d) İnceleme, gözlem ve deney yapma becerilerine göre
e) Grup çalışmalarına göre
f) Diğer:…….....

8. Astronomiyi öğrenmek size ne tür faydalar sağlayabilir? En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Doğru düşünme
b) Gündelik yaşamla ilgili bilgiler edinme
c) Dünya ve evreni daha iyi tanıma ve bilgi edinme
d) Astronomi ile ilgili halkın yanlış bilgilerini ve inanışlarını yok etme
e) Astronomi ile ilgili malzemeleri kullanma (dürbün, teleskop v.b)
f) Diğer:.....

9. Astronomi ile ilgili öğrendiklerinizi arkadaşlarınız ve çevrenizle nasıl paylaşabilirsiniz? En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Sınıf içinde astronomi ile ilgili filmler ve belgeseller izleme, fotoğraflar görme ile
b) Gruplar halinde astronomiyle ilgili konularda gözlem ve araştırma yapma ile
c) Astronomi ile ilgili değişik haberleri sınıf içinde paylaşma ile
d) Diğer:.....

10. Astronomi derslerini nasıl bir eğitim ortamında öğrenmek istersiniz?En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Öğretmenin bilgileri aktardığı bir ortamda
b) Grup çalışmalarının esas alındığı bir eğitim ortamında
c) Çalışmaların tek başına yapıldığı bir ortamda
d) Öğretmen-öğrenci işbirliğinin önemli olduğu bir ortamda
e) Diğer:.....

11. Astronomi dersleri için ne tür olanakların yaratılmasını istersiniz? En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Televizyon veya video gibi araçların olduğu bir ortam
b) Tepegöz (yansıtıcı) veya slayt gibi araçların olduğu bir ortam
c) Konularla ilgili malzemelerin, modellerin ve maketlerin bulunduğu laboratuar ortamı
d) Hikaye veya senaryolarla hazırlanmış etkinliklerin oynanabileceği sınıf içi ortamlar
e) Sınıf dışı araştırma ve inceleme yapma olanağı veren bir ortam (kütüphane gibi)
f) Astronomi ile ilgili düzenli dergi veya kitap aboneliği
g) Öğrencilerin astronomi ile ilgili fikirlerini dile getirebileceği tartışma ortamları
h) Diğer:.....

12. Astronomiyi eğitimiyle bilime ve teknolojiye olan ilginizin artacağına inanıyor musunuz? Uygun seçeneği işaretleyip, nedenlerini kısaca yazınız.

- Evet. Çünkü;.....
- Hayır.Çünkü;.....

13. Sosyal Bilgisi veya Fen Bilgisi derslerinde anlatılan astronomi konuları (örneğin; Samanyolu galaksisi, Güneş sistemi, Güneş-Ay tutulması, gel-git olayı vs.) ile ilgili anlayamadığınız konular nelerdir? Nasıl anlatılmasını istersiniz?

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

14. Hazırlanacak bir astronomi dersi için sizin önerileriniz nelerdir?

……
……
…….....

Katkılarınızdan dolayı teşekkür ederim.

APPENDIX L

INITIAL VERSION OF "A QUESTIONNAIRE TO DETERMINE THE SECONDARY SCHOOL STUDENTS' OPINIONS ABOUT THE DEVELOPMENT OF THE ASTRONOMY PROGRAM"

ASTRONOMİ ÖĞRETİM PROGRAMI GELİŞTİRİLMESİ HAKKINDA ORTAÖĞRETİM ÖĞRENCİLERİNİN GÖRÜŞLERİNİ BELİRLEME ANKETİ

Bu anket, İlköğretim ve Ortaöğretim öğrencilerine uygulanarak, geliştirilmesi düşünülen Astronomi Öğretim Programı hakkında onların düşüncelerini almak ve program ile ilgili genel bir çerçeve yaratmak amacıyla hazırlanmıştır.

Amaçlar:

Anketteki maddeler aşağıdaki ölçütler dikkate alınarak belirlenmiştir:

1) Amaçlara ilişkin ölçütler
    a. Bilimsel bilgi (3. , 4. sorular)
    b. Bilimsel tutum ve değer (8. , 12. sorular)
    c. Bilişsel süreç ve beceriler (8. ,9. sorular)
2) İçeriğe ilişkin ölçütler (2. , 3. , 4. sorular)
3) Öğretme-öğrenme süreçlerine ilişkin ölçütler (5., 6. sorular)
4) Değerlendirmeye ilişkin ölçütler (7. soru)
5) Öğretim ortamına ve olanaklara ilişkin ölçütler (10. ve 11. sorular)

Açıklama:

Aşağıdaki sorular hazırlanacak bir astronomi dersi için görüşlerinizi almak amacıyla sorulmuştur.Lütfen, soruları dikkatli okuyup cevaplandırınız.

Yönerge 1:

Aşağıdaki cinsiyet ile ilgili size uygun olanı seçeneği yuvarlak içine alınız. Ayrıca okul türünüz, sınıfınız, anne ve babanızın eğitim durumu ile ilgili bilgileri yazınız.

Cinsiyetiniz:

[K] Kız [E] Erkek

Okul türünüz:.....

Sınıfınız:…….....

Annenizin eğitim durumu:.....

Babanızın eğitim durumu:.....

Yönerge 2:

Astronomi konularını Fizik veya Coğrafya dersi içinde mi yoksa ayrı bir ders olarak mı öğrenmek istersiniz? Aşağıda verilen tabloda size uygun olan kutucuğa çarpı [**X**] işareti koyunuz ve nedenini yazınız.

Bir ders altında okumak istiyorum (Fizik veya Coğrafya)	**Ayrı bir ders olarak okumak istiyorum**	**Fark etmez**	**GEREKÇENİZ**

Yönerge 3:

Aşağıda verilmiş olan Astronomi konularından öğrenmek istediğinizin yanındaki tercih bölümüne **Artı (+)** işareti, öğrenmek istemediğinizin yanındaki tercih bölümüne de **Eksi (-)** işareti koyunuz ve yaptığınız tercihin nedenlerini kısaca yazınız.

KONULAR	TERCİH	GEREKÇENİZ
1) Işık bilgisi ve Gölge (ışığın davranışı, yarı gölge ve tam gölge oluşumu)		
2) Güneş-Dünya ve Ay arasındaki ilişkiler ve bu ilişkilerin sonuçları (Güneş ve Ay tutulmaları)		
3) Güneşin özellikleri, Güneş sistemi ve bu sistemdeki cisimlerin hareketleri (güneş sistemindeki gezegenlerin ve nesnelerin yörünge hareketleri)		
4) Dünyanın ve diğer gezegenlerin Güneş sistemindeki yeri ve hareketi		
5) Dünyanın kendi ve Güneş sistemindeki hareketi ve bu hareketin sonuçları (gece-gündüzün, yılın ve mevsimlerin oluşumu)		
6) Kütle çekim kuvveti ve bu kuvvetin cisimler üzerindeki etkisi (yerçekimi ve gel-git olayı)		
7) Güneşin Dünyadaki yaşam üzerindeki etkisi (enerji kaynağı olarak güneşin önemi ve dünyadaki ekolojik sisteme olan etkisi)		
8) Nebula gaz bulutu ve evrenin oluşumu (evrenin başlangıcı, büyük patlama teorisi ve evrenin genişlemesiyle ilgili teoriler)		
9) Yıldız ve galaksilerin doğuşu, yapısı ve evrimi		
10) Evrenin kütlesi (görünür kütle kavramı)		
11) Zaman ve Takvim bilgisi		
12) Burçlar		
13) Astronomi aletleri ve kullanıldığı alanlar		

14) Astronomi tarihi		
15) Uzay çalışmaları		
16) Evrende yaşam		

Yönerge 4:

Bir önceki soruda verilen tabloda olmayan, ama öğrenmek istediğiniz başka astronomi konuları varsa bu konuların adını ve neden konulması gerektiğini yazınız.

ASTRONOMİ KONUSU	GEREKÇENİZ

5. Okulunuzda bir astronomi dersinin olduğunu varsayın bu dersi iyi öğrenmek için nelerin yapılmasını istersiniz? En çok istediğinizden, en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız. (Örnek: "En çok istediğinizin yanına (1), daha az istediğinizin yanına (2) şeklinde rakam vererek sıralayınız)

a) Konuların bütünlük içinde verilmesini
b) Günlük hayatla bağlantı kurulmasını
c) Konuları basit formüllerle verilmesini
d) Konuların anlaşılır bilgilerle verilmesini
e) Basit ve anlaşılır deneyler hazırlanmasını
f) Önbilgi eksikliklerinin ve kavram yanılgılarının ortaya çıkarılmasını
g) Konulara yeterli süre verilmesini
h) Diğer:……..

6. Astronomi dersini aşağıdaki hangi yöntemlerle öğrenmek istersiniz? Açıklayınız. En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Bilginin sadece öğretmen tarafından verildiği bir yöntem ile.Çünkü;.....
b) Deney ve gözlem ile. Çünkü;.....
c) Proje çalışması ile. Çünkü;.....
d) Araştırma ve tartışma ortamı ile. Çünkü;.....
e) Grup çalışması ile. Çünkü;.....
f) Sınıf içi oyunlar ile. Çünkü;.....
g) İlgi alanımız ve bilgi seviyemize göre hazırlanmış etkinlikler ile. Çünkü;.....
h) Bilgisayar destekli yöntemler ile. Çünkü;.....
i) Diğer:……...

7. Astronomi dersinde aşağıdakilerden hangilerinin dikkate alınarak not verilmesini istersiniz?En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Yazılı ve sözlü sınav sonuçlarına göre
b) Proje çalışmaları sonuçlarına göre

c) Dönem boyunca sınıf içi gözlemlere göre
d) İnceleme, gözlem ve deney yapma becerilerine göre
e) Grup çalışmalarına göre
f) Diğer:…….....

8. Astronomiyi öğrenmek size ne tür faydalar sağlayabilir? <u>En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.</u>

a) Doğru düşünme
b) Gündelik yaşamla ilgili bilgiler edinme
c) Dünya ve evreni daha iyi tanıma ve bilgi edinme
d) Astronomi ile ilgili halkın yanlış bilgilerini ve inanışlarını yok etme
e) Astronomi ile ilgili malzemeleri kullanma (dürbün, teleskop v.b)
f) Diğer:.....

9. Astronomi ile ilgili öğrendiklerinizi arkadaşlarınız ve çevrenizle nasıl paylaşabilirsiniz? <u>En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.</u>

a) Sınıf içinde astronomi ile ilgili filmler ve belgeseller izleme, fotoğraflar görme ile
b) Gruplar halinde astronomiyle ilgili konularda gözlem ve araştırma yapma ile
c) Astronomi ile ilgili değişik haberleri sınıf içinde paylaşma ile
d) Diğer:.....

10. Astronomi derslerini nasıl bir eğitim ortamında öğrenmek istersiniz?<u>En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.</u>

a) Öğretmenin bilgileri aktardığı bir ortamda
b) Grup çalışmalarının esas alındığı bir eğitim ortamında
c) Çalışmaların tek başına yapıldığı bir ortamda
d) Öğretmen-öğrenci işbirliğinin önemli olduğu bir ortamda
e) Diğer:.....

11. Astronomi dersleri için ne tür olanaklardan yararlanılmasını istersiniz? En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.

a) Televizyon veya video gibi araçların olduğu bir ortam
b) Tepegöz (yansıtıcı) veya slayt gibi araçların olduğu bir ortam
c) Konularla ilgili malzemelerin, modellerin ve maketlerin bulunduğu laboratuar ortamı
d) Hikaye veya senaryolarla hazırlanmış etkinliklerin oynanabileceği sınıf içi ortamlar
e) Sınıf dışı araştırma ve inceleme yapma olanağı veren bir ortam (kütüphane gibi)
f) Astronomi ile ilgili düzenli dergi veya kitap aboneliği
g) Öğrencilerin astronomi ile ilgili fikirlerini dile getirebileceği tartışma ortamları
h) Diğer:.....

12. Astronomiyi eğitimiyle bilime ve teknolojiye olan ilginizin artacağına inanıyor musunuz? Uygun seçeneği işaretleyip, nedenlerini kısaca yazınız.

- Evet. Çünkü;.....
- Hayır.Çünkü;.....

13. Fizik veya Coğrafya derslerinde anlatılan astronomi konuları ile ilgili anlayamadığınız konular nelerdir? Nasıl anlatılmasını istersiniz?

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

14. Hazırlanacak bir astronomi dersi için sizin önerileriniz nelerdir?

……
……
…….....

Katkılarınızdan dolayı teşekkür ederim.

APPENDIX M

FINAL VERSION OF "A QUESTIONNAIRE TO DETERMINE THE TEACHERS' OPINIONS ABOUT THE DEVELOPMENT OF THE ASTRONOMY PROGRAM"

Astronomi Öğretim Programını Geliştirmek İçin Öğretmen ve Uzman Görüşlerini Belirleme Anketi

2004 – 2005

Bu anket Sınıf Öğretmeni, Fen Bilgisi, Fizik Öğretmenleri ve Astronomi ile ilgili uzmanlardan, geliştirilmesi düşünülen Astronomi Öğretim Programı hakkında düşüncülerini almak ve program ile ilgili genel bir çerçeve yaratmak amacıyla hazırlanmıştır.

Anketteki maddeler aşağıdaki ölçütler dikkate alınarak belirlenmiştir:

Ölçütler	**Yönerge**
Amaçlara İlişkin (Bilimsel Bilgi, Bilimsel Tutum ve Değer, Bilişsel Süreç ve Beceriler)	6.1, 6.2 ve 6.4
İçeriğe İlişkin	2, 3 ve 4
Öğretme-öğrenme Süreçlerine İlişkin	5.1 ve 5.2
Değerlendirmeye İlişkin	5.4
Öğretim Ortamına ve Olanaklara İlişkin	5.3 ve 6.3

Açıklama:

Aşağıdaki sorular hazırlanacak bir astronomi dersi için görüşlerinizi almak amacıyla sorulmuştur. Lütfen, soruları dikkatli okuyup cevaplandırınız.

Yönerge 1:

Astronomi konuları Anaokulu–3, 4–5, 6–8 ve 9–11 sınıf aralıklarında nasıl okutulmalıdır? Aşağıda verilen tabloda size uygun olan kutucuğu [**X**] işareti koyarak işaretleyiniz ve gerekçenizi belirtiniz.

Sınıf	Bir ders altında okutulmalıdır	Ayrı bir ders olarak okutulmalıdır	Fark etmez	Gerekçeniz
A–3				
4–5				
6–8				
9–11				

Yönerge 2 ve 3 :

Aşağıdaki tabloda verilen konular, bir astronomi öğretim programı için belirlenmiş konulardır, bu konuların öğretim programda öğretilmesinin gerekli olup olmadığını aşağıda verilen derecelerden uygun gördüğünüzü seçerek değerlendirme sütununda işaretleyeniz. Konuları verilebilecek uygun sınıf seviyelerine göre düzenlemenizi istersek, hangi konunun hangi sınıf seviyesinde verilmesini isterdiniz? Gerekçeniz nedir?

Konuların Gereklilik Düzeyi		**Uygun Sınıf Seviyesi**
Gereksiz	[0]	[1] Anaokulu'ndan – 3' e kadar
Çok Gerekli Değil	[1]	[2] 4' ten – 5' e kadar
Ne Gerekli Ne Gereksiz	[2]	[3] 6' dan – 8' e kadar
Gerekli	[3]	[4] 9' dan – 11' e kadar
Çok Gerekli	[4]	

Konular	**Değerlendirme** [0] [1] [2] [3] [4]	**Sınıf** [1] [2] [3] [4]	**Gerekçeniz**
1. Işık ve Gölge Bilgisi (Örnek: Işığın Davranışı, Yarı Gölge ve Tam Gölge Oluşumu)	○ ○ ○ ○ ○	○ ○ ○ ○	
2. Kütle Çekim Kuvveti ve Bu Kuvvetin Cisimler Üzerindeki Etkisi (Örnek: Yerçekimi ve Gel-git)	○ ○ ○ ○ ○	○ ○ ○ ○	
3. Güneşin ve Güneş Sistemindeki Gezegenlerin Hareketi (Örnek: Gezegenlerin Yörüngeleri ve Özellikleri	○ ○ ○ ○ ○	○ ○ ○ ○	
4. Güneş sisteminde kütle çekim kuvvetinin rolü	○ ○ ○ ○ ○	○ ○ ○ ○	
5. Güneşin Dünyadaki yaşam üzerindeki etkisi (Örnek: Enerji Kaynağı Olarak Güneş'in Önemi ve Dünyadaki Ekolojik Sisteme Olan Etkisi)	○ ○ ○ ○ ○	○ ○ ○ ○	

6. Dünyanın Günlük ve Güneş Çevresindeki Hareketi (Örnek: Gece-Gündüzün, Yılın ve Mevsimlerin Oluşumu)	○ ○ ○ ○ ○	○ ○ ○ ○	
7. Dünya'nın ekseninin eğriliği ve bunun sonuçları	○ ○ ○ ○ ○	○ ○ ○ ○	
8. Güneş-Dünya ve Ay Arasındaki ilişkiler (Örnek: Güneş ve Ay Tutulmaları)	○ ○ ○ ○ ○	○ ○ ○ ○	
9. Görelilik (Rölativite) (Örnek: Basit Düzeyde Işığın Hızı ve Hareketi, Genel ve Özel Görelilik)	○ ○ ○ ○ ○	○ ○ ○ ○	
10. Astronomi Tarihi (Örnek: Kopernik, Kepler, Galileo, Tycho ve Newton)	○ ○ ○ ○ ○	○ ○ ○ ○	
11. Zaman ve Takvim Bilgisi	○ ○ ○ ○ ○	○ ○ ○ ○	
12. Teleskop, Uydular ve Kullanıldığı Alanlar (Örnek: Detektörler, Uydu Çeşitleri, Eski Astronomi Aletleri)	○ ○ ○ ○ ○	○ ○ ○ ○	
13. Uzay Çalışmaları (Örnek: Apollo, Hubble)	○ ○ ○ ○ ○	○ ○ ○ ○	
14. Yıldızlar ve Büyük Gök Cisimleri (Örnek: Bulutsular, Gökadalar)	○ ○ ○ ○ ○	○ ○ ○ ○	
15. Evrenin Yapısı ve Evrimi (Örnek: Yıldız ve Galaksilerin Doğuşu, Yapısı ve Evrimi)	○ ○ ○ ○ ○	○ ○ ○ ○	
16. Evrenin genişlemesi ve evrenin kaderi (Örnek: Bing-Bang Teorisi, Evrenin Genişlemesi ile İlgili Teoriler)	○ ○ ○ ○ ○	○ ○ ○ ○	
17. Evrendeki Diğer Yaşam Formları ve Diğer Güneş Sistemleri	○ ○ ○ ○ ○	○ ○ ○ ○	
18. Gökyüzünün Sanal Çizgileri: Burçlar	○ ○ ○ ○ ○	○ ○ ○ ○	

Yönerge 4:

Bir önceki soruda verilen tabloda olmayan, ama öğretmek istediğiniz başka **astronomi** konuları varsa, bu konuların adını, konması gereken sınıf seviyesini ve neden konulması gerektiğini aşağıdaki tabloya lütfen yazınız.

Konular	**Sınıf** [1] [2] [3] [4]	**Gerekçeniz**
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	
	○ ○ ○ ○	

Açıklama:

Aşağıdaki soruları dikkatlice okuyunuz ve cevaplandırınız.

Yönerge 5.1:

Hazırlanacak astronomi programında, öğrencilerin öğrenme sürecini sorunsuz tamamlamak ve oluşabilecek anlama zorluklarını ve kavram yanılgılarını engellemek için genel olarak alınması gereken önlemler neler olmalıdır? ***En çok istediğinizden, en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Konuların bütünlük içinde verilmesini
( ) Günlük hayatla bağlantı kurulmasını
( ) Konuları basit formüllerle verilmesini
( ) Konuların anlaşılır bilgilerle verilmesini
( ) Basit ve anlaşılır deneyler hazırlanmasını
( ) Önbilgi eksikliklerinin ve kavram yanılgılarının ortaya çıkarılmasını
( ) Konulara yeterli süre verilmesini
( ) Diğer:……..

Yönerge 5.2:

Astronomi dersini aşağıdaki hangi yöntemlerle öğretmek istersiniz? Açıklayınız. ***En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Bilginin sadece öğretmen tarafından verildiği bir yöntem ile.Çünkü;.....

( ) Deney ve gözlem ile. Çünkü;.....

( ) Proje çalışması ile. Çünkü;.....

( ) Araştırma ve tartışma ortamı ile. Çünkü;.....

( ) Grup çalışması ile. Çünkü;.....

( ) Sınıf içi oyunlar ile. Çünkü;.....

( ) İlgi alanımız ve bilgi seviyemize göre hazırlanmış etkinlikler ile. Çünkü;.....

( ) Bilgisayar destekli yöntemler ile. Çünkü;.....

( ) **Diğer:**…….. Çünkü;.....

Yönerge 5.3:

Astronomi dersi içinde neler öğretmek istersiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Astronomi ile ilgili yapılmış/yapılacak proje çalışmalarını (Örneğin, Mars'a Yolculuk Projesi)

( ) Güncel gelişmeleri içeren konuları (Örneğin, Yeni Bir Gezegenin Bulunması)

( ) Gündelik yaşamla ilişkili konuları (Örneğin, Güneş-Ay Tutulması)

( ) Astronomi tarihi (Örneğin, Astronominin Gelişim Süreci)

( ) **Diğer:**.....

Yönerge 5.4:

Astronomi dersinde nasıl bir değerlendirme yöntemi kullanılmalıdır? ***En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Yazılı ve sözlü sınav sonuçlarına göre
( ) Proje çalışmaları sonuçlarına göre
( ) Dönem boyunca sınıf içi gözlemlere göre
( ) İnceleme, gözlem ve deney yapma becerilerine göre
( ) Grup çalışmalarına göre
( ) **Diğer:**…….....

Açıklama:

Aşağıdaki soruları dikkatlice okuyunuz ve cevabınızı verilen boşluklara lütfen yazınız.

Yönerge 6.1:

Astronomi öğretim programı ile öğrencilerin bilimsel tutum ve değerlerinde ne tür değişimler sağlanabilir?

…….
……..
……
…….

Yönerge 6.2:

Astronomi öğretim programı öğrencilerin bilişsel süreçleri ve becerilerinde ne tür gelişmeler sağlayabilir?

…….
…….
……
……..……

Yönerge 6.3:

Astronomi öğretim programı ile öğrencilere sınıf içi, okul, eğitim ortamı ve yaşadığı çevre açısından ne tür olanaklar sağlanabilir?

……
……
……
……

Yönerge 6.4:

Astronomi konusunu, Sosyal Bilgisi, Fen Bilgisi, Fizik veya Coğrafya (hangi branşta iseniz onu düşünerek cevaplayınız) dersleri içinde verirken sorun olarak gördüğünüz noktalar nelerdir?

……
……
…….....
.....

Yönerge 6.5:

Hazırlanacak bir astronomi öğretim programı için yukarıda bahsedilmeyen görüş ve önerileriniz neler olabilir?

……
……
……
……

Katkılarınızdan dolayı teşekkür ederim.

APPENDIX N

FINAL VERSION OF "A QUESTIONNAIRE TO DETERMINE THE ELEMENTARY STUDENTS' OPINIONS ABOUT THE DEVELOPMENT OF THE ASTRONOMY PROGRAM"

Astronomi Öğretim Programını Geliştirmek İçin Öğrenci Görüşlerini Belirleme Anketi

2004 – 2005

Bu anket, İlköğretim öğrencilerine uygulanarak, geliştirilmesi düşünülen Astronomi Öğretim Programı hakkında onların düşüncelerini almak ve program ile ilgili genel bir çerçeve yaratmak amacıyla hazırlanmıştır.

Anketteki maddeler aşağıdaki ölçütler dikkate alınarak belirlenmiştir:

Ölçütler	**Yönerge**
Amaçlara İlişkin (Bilimsel Bilgi, Bilimsel Tutum ve Değer, Bilişsel Süreç ve Beceriler)	3, 4, 5.5, 5.6 ve 5.8
İçeriğe İlişkin	2, 3 ve 4
Öğretme-öğrenme Süreçlerine İlişkin	5.1 ve 5.2
Değerlendirmeye İlişkin	5.4
Öğretim Ortamına ve Olanaklara İlişkin	5.3 ve 5.7

Açıklama:

Aşağıdaki sorular hazırlanacak bir astronomi dersi için görüşlerinizi almak amacıyla sorulmuştur. Lütfen, soruları dikkatli okuyup cevaplandırınız.

Yönerge 1:

Aşağıdaki cinsiyet ile ilgili size uygun olan kutucuğa çarpı [**X**] işareti koyunuz. Ayrıca sınıfınız, anne ve babanızın eğitim durumu ve okulunuz ile ilgili bilgileri yazınız.

Cinsiyetiniz : ☐ Kız ☐ Erkek

Sınıfınız :.....

Annenizin Eğitim Durumu :.....

Babanızın Eğitim Durumu :.....

Okulunuz :.....

Yönerge 2:

Astronomi konularını Sosyal Bilgisi veya Fen Bilgisi dersi içinde mi yoksa ayrı bir ders olarak mı öğrenmek istersiniz? Aşağıda verilen tabloda size uygun olan kutucuğa çarpı [**X**] işareti koyunuz ve nedenini kutucuk içerisine yazınız.

☐ Bir ders altında okumak istiyorum (Sosyal Bilgisi veya Fen Bilgisi dersleri altında)

☐ Ayrı bir ders olarak okumak istiyorum

☐ Fark etmez

GEREKÇENİZ:

Yönerge 3:

Aşağıda verilmiş olan Astronomi konularından öğrenmek istediğinizin yanındaki tercih bölümüne **Artı (+)** işareti, öğrenmek istemediğinizin yanındaki tercih bölümüne de **Eksi (-)** işareti koyunuz ve yaptığınız tercihin nedenlerini kısaca yazınız.

Konular	**(+)**	**(-)**	**Gerekçeniz**
1. Işık ve Gölge Bilgisi (Örnek: Işığın Davranışı, Yarı Gölge ve Tam Gölge Oluşumu)	☐	☐	
2. Kütle Çekim Kuvveti ve Bu Kuvvetin Cisimler Üzerindeki Etkisi (Örnek: Yerçekimi ve Gel-git olayı)	☐	☐	
3. Güneşin ve Güneş Sistemindeki Gezegenlerin Hareketi (Örnek: Gezegenlerin Yörüngeleri ve Özellikleri)	☐	☐	
4. Güneşin Dünyadaki yaşam üzerindeki etkisi (Örnek: Enerji Kaynağı Olarak Güneş'in Önemi ve Dünyadaki Ekolojik Sisteme Olan Etkisi)	☐	☐	
5. Dünyanın Günlük ve Güneş Çevresindeki Hareketi (Örnek: Gece-Gündüzün, Yılın ve Mevsimlerin Oluşumu)	☐	☐	
6. Güneş-Dünya ve Ay Arasındaki ilişkiler (Örnek: Güneş ve Ay Tutulmaları)	☐	☐	
7. Astronomi Tarihi (Örnek: Kopernik, Kepler, Galileo, Tycho ve Newton	☐	☐	
8. Zaman ve Takvim Bilgisi	☐	☐	
9. Teleskop, Uydular ve Kullanıldığı Alanlar	☐	☐	
10. Uzay Çalışmaları (Örnek: Apollo, Hubble)	☐	☐	
11. Yıldızlar ve Büyük Gök Cisimleri (Örnek: Bulutsular, Gökadalar)	☐	☐	
12. Evrenin Yapısı ve Evrimi (Örnek: Yıldız ve Galaksilerin Doğuşu, Yapısı ve Evrimi)	☐	☐	
13. Evrendeki Diğer Yaşam Formları ve Diğer Güneş Sistemleri	☐	☐	
14. Gökyüzünün Sanal Çizgileri: Burçlar	☐	☐	

Yönerge 4:

Bir önceki soruda verilen tabloda olmayan, ama öğrenmek istediğiniz başka **astronomi** konuları varsa bu konuların adını ve neden konulması gerektiğini yazınız.

Konular	**Gerekçeniz**

Açıklama:

Aşağıdaki soruları dikkatlice okuyunuz ve cevaplandırınız.

Yönerge 5.1:

Okulunuzda bir astronomi dersinin olduğunu varsayın bu dersi iyi öğrenmek için nelerin yapılmasını istersiniz? ***En çok istediğinizden, en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Konuların bütünlük içinde verilmesini
( ) Günlük hayatla bağlantı kurulmasını
( ) Konuları basit formüllerle verilmesini
( ) Konuların anlaşılır bilgilerle verilmesini
( ) Basit ve anlaşılır deneyler hazırlanmasını
( ) Önbilgi eksikliklerinin ve kavram yanılgılarının ortaya çıkarılmasını
( ) Konulara yeterli süre verilmesini
( ) **Diğer:** .....

Yönerge 5.2:

Astronomi dersini aşağıdaki hangi yöntemlerle öğrenmek istersiniz? Açıklayınız. ***En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Bilginin sadece öğretmen tarafından verildiği bir yöntem ile.Çünkü;.....

( ) Deney ve gözlem ile. Çünkü;.....

( ) Proje çalışması ile. Çünkü;.....

( ) Araştırma ve tartışma ortamı ile. Çünkü;.....

( ) Grup çalışması ile. Çünkü;.....

( ) Sınıf içi oyunlar ile. Çünkü;.....

( ) İlgi alanımız ve bilgi seviyemize göre hazırlanmış etkinlikler ile. Çünkü;.....

( ) Bilgisayar destekli yöntemler ile. Çünkü;.....

( ) **Diğer:**…….. Çünkü;.....

Yönerge 5.3:

Astronomi derslerini nasıl bir eğitim ortamında öğrenmek istersiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Öğretmenin bilgileri aktardığı bir ortamda

( ) Grup çalışmalarının esas alındığı bir eğitim ortamında

( ) Çalışmaların tek başına yapıldığı bir ortamda

( ) Öğretmen-öğrenci işbirliğinin önemli olduğu bir ortamda

( ) **Diğer:**.....

Yönerge 5.4:

Astronomi dersinde aşağıdakilerden hangilerinin dikkate alınarak not verilmesini istersiniz? ***En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Yazılı ve sözlü sınav sonuçlarına göre

( ) Proje çalışmaları sonuçlarına göre

( ) Dönem boyunca sınıf içi gözlemlere göre

( ) İnceleme, gözlem ve deney yapma becerilerine göre

( ) Grup çalışmalarına göre

( ) **Diğer:**…….....

Yönerge 5.5:

Astronomiyi öğrenmek size ne tür faydalar sağlayabilir***? En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Doğru düşünme

( ) Gündelik yaşamla ilgili bilgiler edinme

( ) Dünya ve evreni daha iyi tanıma ve bilgi edinme

( ) Astronomi ile ilgili halkın yanlış bilgilerini ve inanışlarını yok etme

( ) Boyut kavramı (büyüklükler, uzaklıklar ve ağırlıklar arası ilişki) ile ilgili bilgi edinme

( ) Astronomi ile ilgili malzemeleri kullanma (dürbün, teleskop v.b)

( ) **Diğer:**.....

Yönerge 5.6:

Astronomi ile ilgili öğrendiklerinizi arkadaşlarınız ve çevrenizle nasıl paylaşabilirsiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Sınıf içinde astronomi ile ilgili filmler ve belgeseller izleme, fotoğraflar görme ile

( ) Gruplar halinde astronomiyle ilgili konularda gözlem ve araştırma yapma ile

( ) Astronomi ile ilgili değişik haberleri sınıf içinde paylaşma ile

( ) **Diğer:**.....

Yönerge 5.7:

Astronomi dersleri için ne tür olanakların yaratılmasını istersiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Televizyon veya video gibi araçların olduğu bir ortam

( ) Tepegöz (yansıtıcı) veya slayt gibi araçların olduğu bir ortam

( ) Konularla ilgili malzemelerin, modellerin ve maketlerin bulunduğu laboratuar ortamı

( ) Hikaye veya senaryolarla hazırlanmış etkinliklerin oynanabileceği sınıf içi ortamlar

( ) Sınıf dışı araştırma ve inceleme yapma olanağı veren bir ortam (kütüphane gibi)

( ) Astronomi ile ilgili düzenli dergi veya kitap aboneliği

( ) Öğrencilerin astronomi ile ilgili fikirlerini dile getirebileceği tartışma ortamları

( ) Diğer:.....

Yönerge 5.8:

Astronomi eğitimiyle bilime ve teknolojiye olan ilginizin artacağına inanıyor musunuz? Uygun seçeneği işaretleyip, nedenlerini kısaca yazınız.

- Evet. Çünkü;.....
- Hayır.Çünkü;.....

Yönerge 5.9:

Sosyal Bilgisi veya Fen Bilgisi derslerinde verilen astronomi konularından (Örneğin; Samanyolu, Güneş sistemi, Güneş-Ay tutulması, gel-git olayı vs.) zorlandıklarınız nelerdir? Nasıl anlatılmalı?

GEREKÇENİZ:

Katkılarınızdan dolayı teşekkür ederim.

APPENDIX P

FINAL VERSION OF "A QUESTIONNAIRE TO DETERMINE THE SECONDARY SCHOOL STUDENTS' OPINIONS ABOUT THE DEVELOPMENT OF THE ASTRONOMY PROGRAM"

Astronomi Öğretim Programını Geliştirmek İçin Öğrenci Görüşlerini Belirleme Anketi

2004 – 2005

Bu anket, Orta Öğretim öğrencilerine uygulanarak, geliştirilmesi düşünülen Astronomi Öğretim Programı hakkında onların düşüncelerini almak ve program ile ilgili genel bir çerçeve yaratmak amacıyla hazırlanmıştır.

Anketteki maddeler aşağıdaki ölçütler dikkate alınarak belirlenmiştir:

Ölçütler	**Yönerge**
Amaçlara İlişkin (Bilimsel Bilgi, Bilimsel Tutum ve Değer, Bilişsel Süreç ve Beceriler)	3, 4, 5.5, 5.6 ve 5.8
İçeriğe İlişkin	2, 3 ve 4
Öğretme-öğrenme Süreçlerine İlişkin	5.1 ve 5.2
Değerlendirmeye İlişkin	5.4
Öğretim Ortamına ve Olanaklara İlişkin	5.3 ve 5.7

Açıklama:

Aşağıdaki sorular hazırlanacak bir astronomi dersi için görüşlerinizi almak amacıyla sorulmuştur. Lütfen, soruları dikkatli okuyup cevaplandırınız.

Yönerge 1:

Aşağıdaki cinsiyet ile ilgili size uygun olan kutucuğa çarpı [**X**] işareti koyunuz. Ayrıca sınıfınız, anne ve babanızın eğitim durumu ve okulunuz ile ilgili bilgileri yazınız.

Cinsiyetiniz : ☐ Kız ☐ Erkek

Sınıfınız :.....

Annenizin Eğitim Durumu :.....

Babanızın Eğitim Durumu :.....

Okul Türünüz :.....

Yönerge 2:

Astronomi konularını Fizik veya Coğrafya dersi içinde mi yoksa ayrı bir ders olarak mı öğrenmek istersiniz? Aşağıda verilen tabloda size uygun olan kutucuğa çarpı [**X**] işareti koyunuz ve nedenini kutucuk içerisine yazınız.

☐ Bir ders altında okumak istiyorum (Fizik, Coğrafya v.s)

☐ Ayrı bir ders olarak okumak istiyorum

☐ Fark etmez

GEREKÇENİZ:

Yönerge 3:

Aşağıda verilmiş olan Astronomi konularından öğrenmek istediğinizin yanındaki tercih bölümüne **Artı (+)** işareti, öğrenmek istemediğinizin yanındaki tercih bölümüne de **Eksi (-)** işareti koyunuz ve yaptığınız tercihin nedenlerini kısaca yazınız.

Konular	**(+)**	**(-)**	**Gerekçeniz**
1. Işık ve Gölge Bilgisi (Örnek: Işığın Davranışı, Yarı Gölge ve Tam Gölge Oluşumu)	☐	☐	
2. Kütle Çekim Kuvveti ve Bu Kuvvetin Cisimler Üzerindeki Etkisi (Örnek: Yerçekimi ve Gel-git olayı)	☐	☐	
3. Güneşin ve Güneş Sistemindeki Gezegenlerin Hareketi (Örnek: Gezegenlerin Yörüngeleri ve Özellikleri	☐	☐	
4. Güneşin Dünyadaki yaşam üzerindeki etkisi (Örnek: Enerji Kaynağı Olarak Güneş'in Önemi ve Dünyadaki Ekolojik Sisteme Olan Etkisi)	☐	☐	
5. Dünyanın Günlük ve Güneş Çevresindeki Hareketi (Örnek: Gece-Gündüzün, Yılın ve Mevsimlerin Oluşumu)	☐	☐	
6. Güneş-Dünya ve Ay Arasındaki ilişkiler (Örnek: Güneş ve Ay Tutulmaları)	☐	☐	
7. Astronomi Tarihi (Örnek: Kopernik, Kepler, Galileo, Tycho ve Newton)	☐	☐	
8. Zaman ve Takvim Bilgisi	☐	☐	
9. Teleskop, Uydular ve Kullanıldığı Alanlar	☐	☐	
10. Uzay Çalışmaları (Örnek: Apollo, Hubble)	☐	☐	
11. Yıldızlar ve Büyük Gök Cisimleri (Örnek: Bulutsular, Gökadalar)	☐	☐	
12. Evrenin Yapısı ve Evrimi (Örnek: Yıldız ve Galaksilerin Doğuşu, Yapısı ve Evrimi)	☐	☐	
13. Evrendeki Diğer Yaşam Formları ve Diğer Güneş Sistemleri	☐	☐	
14. Gökyüzünün Sanal Çizgileri: Burçlar	☐	☐	

Yönerge 4:

Bir önceki soruda verilen tabloda olmayan, ama öğrenmek istediğiniz başka **astronomi** konuları varsa bu konuların adını ve neden konulması gerektiğini yazınız.

Konular	Gerekçeniz

Açıklama:

Aşağıdaki soruları dikkatlice okuyunuz ve cevaplandırınız.

Yönerge 5.1:

Okulunuzda bir astronomi dersinin olduğunu varsayın bu dersi iyi öğrenmek için nelerin yapılmasını istersiniz? ***En çok istediğinizden, en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Konuların bütünlük içinde verilmesini
( ) Günlük hayatla bağlantı kurulmasını
( ) Konuları basit formüllerle verilmesini
( ) Konuların anlaşılır bilgilerle verilmesini
( ) Basit ve anlaşılır deneyler hazırlanmasını
( ) Önbilgi eksikliklerinin ve kavram yanılgılarının ortaya çıkarılmasını
( ) Konulara yeterli süre verilmesini
( ) **Diğer:**……..

Yönerge 5.2:

Astronomi dersini aşağıdaki hangi yöntemlerle öğrenmek istersiniz? Açıklayınız. ***En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Bilginin sadece öğretmen tarafından verildiği bir yöntem ile.Çünkü;.....

( ) Deney ve gözlem ile. Çünkü;.....

( ) Proje çalışması ile. Çünkü;.....

( ) Araştırma ve tartışma ortamı ile. Çünkü;.....

( ) Grup çalışması ile. Çünkü;.....

( ) Sınıf içi oyunlar ile. Çünkü;.....

( ) İlgi alanımız ve bilgi seviyemize göre hazırlanmış etkinlikler ile. Çünkü;.....

( ) Bilgisayar destekli yöntemler ile. Çünkü;.....

( ) **Diğer:**…….. Çünkü;.....

Yönerge 5.3:

Astronomi derslerini nasıl bir eğitim ortamında öğrenmek istersiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Öğretmenin bilgileri aktardığı bir ortamda

( ) Grup çalışmalarının esas alındığı bir eğitim ortamında

( ) Çalışmaların tek başına yapıldığı bir ortamda

( ) Öğretmen-öğrenci işbirliğinin önemli olduğu bir ortamda

( ) **Diğer:**.....

Yönerge 5.4:

Astronomi dersinde aşağıdakilerden hangilerinin dikkate alınarak not verilmesini istersiniz? ***En çok istediğinizden en az istediğinize doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Yazılı ve sözlü sınav sonuçlarına göre

( ) Proje çalışmaları sonuçlarına göre

( ) Dönem boyunca sınıf içi gözlemlere göre

( ) İnceleme, gözlem ve deney yapma becerilerine göre

( ) Grup çalışmalarına göre

( ) **Diğer:**…….....

Yönerge 5.5:

Astronomiyi öğrenmek size ne tür faydalar sağlayabilir***? En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Doğru düşünme

( ) Gündelik yaşamla ilgili bilgiler edinme

( ) Dünya ve evreni daha iyi tanıma ve bilgi edinme

( ) Astronomi ile ilgili halkın yanlış bilgilerini ve inanışlarını yok etme

( ) Boyut kavramı (büyüklükler, uzaklıklar ve ağırlıklar arası ilişki) ile ilgili bilgi edinme

( ) Astronomi ile ilgili malzemeleri kullanma (dürbün, teleskop v.b)

( ) **Diğer:**.....

Yönerge 5.6:

Astronomi ile ilgili öğrendiklerinizi arkadaşlarınız ve çevrenizle nasıl paylaşabilirsiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Sınıf içinde astronomi ile ilgili filmler ve belgeseller izleme, fotoğraflar görme ile

( ) Gruplar halinde astronomiyle ilgili konularda gözlem ve araştırma yapma ile

( ) Astronomi ile ilgili değişik haberleri sınıf içinde paylaşma ile

( ) **Diğer:**.....

Yönerge 5.7 :

Astronomi dersleri için ne tür olanakların yaratılmasını istersiniz? ***En çok önemli gördüğünüzden en az önemli gördüğünüze doğru seçeneklerin yanlarına rakam vererek sıralayınız.***

(Örnek: "En çok istediğinizin yanına **(1)**, daha az istediğinizin yanına **(2)** şeklinde rakam vererek sıralayınız)

( ) Televizyon veya video gibi araçların olduğu bir ortam

( ) Tepegöz (yansıtıcı) veya slayt gibi araçların olduğu bir ortam

( ) Konularla ilgili malzemelerin, modellerin ve maketlerin bulunduğu laboratuar ortamı

( ) Hikaye veya senaryolarla hazırlanmış etkinliklerin oynanabileceği sınıf içi ortamlar

( ) Sınıf dışı araştırma ve inceleme yapma olanağı veren bir ortam (kütüphane gibi)

( ) Astronomi ile ilgili düzenli dergi veya kitap aboneliği

( ) Öğrencilerin astronomi ile ilgili fikirlerini dile getirebileceği tartışma ortamları

( ) Diğer:.....

Yönerge 5.8:

Astronomi eğitimiyle bilime ve teknolojiye olan ilginizin artacağına inanıyor musunuz? Uygun seçeneği işaretleyip, nedenlerini kısaca yazınız.

- Evet. Çünkü;.....
- Hayır.Çünkü;.....

Yönerge 5.9 :

Fizik veya Coğrafya dersleri altında verilen astronomi konularından zorlandıklarınız nelerdir? Nasıl anlatılmalı?

GEREKÇENİZ:

Katkılarınızdan dolayı teşekkür ederim.