ASTRONOMICAL JOURNEYS

diffusion and socialization of the knowledge of the sky

Antônio Araújo Sobrinho

IFRN Editora

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Natal, 2016

I dedicate this work to all my co-workers, students and motorists who have shared with me the hard work in the Astronomical Journeys through cities and towns of Rio Grande do Norte.

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“The Earth is our cradle and it has served us well. But, cradles, although comfortable, become too small. Thus, with the inspiration of those who built the first cathedrals, synagogues, temples and mosques, we aim the cosmos. We live in a really exciting time.”.

Konstantin Tsiolkovsky

To the reader

For 400 years, we have been looking up the sky with tools that enlarge our view capacity. We can see it farther in space and time. with the telescope, we widen thousands, millions and even billion times our visual reach. However, the magic of looking at the sky full of stars is disappearing by using technology. The lighting pollution and haste of the big cities make us busy to stop by and behold the beauty of the night sky or even the sunrise or sunset.

The work Astronomical Journeys (*Jornadas Astronômicas*) reports some activities of a group of teachers and students, whose mission has been the search for collaboration to perform a rescue of magic and charm that the sky offers, and also what technology has taken from us. For we have lost a great part of our nights in closed spaces watching TV programs or connected to the internet and we forget to behold the shows provided by the Moon, Sun, the planets, comets and stars. All the participants of our group visited some cities, talked to teachers, students and their local people. Then, we showed them the sky with the naked eye and with small range equipment. One interesting thing was the receptivity that we had everywhere made us feel happy to share our life experience. So, we worked the sky observation, the identification of celestial bodies with the naked eye and with equipment, and finally, we launched didactic rockets and then, kids as well as adults got involved in the lectures and in the participation activities.

Before, mankind used to catch a glimpse of the nights, made the sky a residence of the Gods, identified the stars and had them as a guide when sailed. Today, although not even all cultures see the sky in the same way (for many peoples the mythological explanations remain alive), we really do it, unstuck from the ground when we sail not only along the seas, but also through the cosmic ocean: we do not

get pleased only by looking at the sky for we found that we are part of it and we inhabit one of the dwelling places in the vast hugeness of this cosmic ocean.

The author.

PREFACE

The idea about writing a book on astronomy is old enough for me for it reminds my childhood and the fascination that the starry sky has upon people, especially me, a person who got upset with the little knowledge acquired in the countryside of Paraíba and Rio Grande do Norte, where I was raised. The precarious lightning of the cities made me see the enchanting of the sky and feel the mysteries which presented before my eyes. What would those little spots shining through the night be? Why, at school, the teacher used to say that illuminated bodies are those which do not have their own light and the luminous ones do? It did not make me either understand or distinguish what was a star or planet, as soon as we observe the night sky without any clouds, everything presents itself light. In other words, looking up the night sky, everything that glows seem to emit light. The Moon, planets, stars, comets, everything shines. So, how can one differentiate luminous bodies from illuminated ones? In my child's point of view, everything which shines is luminous. And what about the constellations? Were there those images in the sky? My eyes just saw the Southern Cross constellation. Explained in this way nothing seemed to be clear to me, on the contrary, I got even more confused because the stars, the Moon and the planets shine at night. People always told me that the Moon presented the same face to the Earth. How could I check that out? I believed that If I could fly up high, I would get to the Moon, planets, Sun, and stars. For me, the Sun was a star different from the others. Actually, now I know, this is it. The Sun is the nearest star to earth and it is this distance that makes us see it during the day, while the other stars can only be visible at night.

Visiting France, Italy, and Greece, places where science and education have more support and stimulus, was also decisive in this task of writing this book. In 1999, I had the pleasure of observing a total eclipse in Europe and got impressed with the organization and structure assem-

bled to give support to people from all over the world that were there as curious ones: lovers or professionals getting delighted with a natural phenomenon that for so long had fascinated and feared mankind. Nowadays, we still have explanations that are not based on scientific arguments. However, we have got more knowledge about the cosmos through equipment we develop to study the sky in the visible and non-visible bands.

The project of observation of the total eclipse of the Sun in the lands of my state, popularly named *Potiguar*, was carried out from march 27th to 29th in the year of 2006, gave us more support to the fulfillment of our child wish. Here, we worked with amateur and professional astronomers from Brazil and kept up daily in touch with others from other parts of the world who shared the same wishes of studying and knowing the mysteries that the sky provides. In this way, we had support of various organizations, such as: IFRN (Federal Institution of Education, Science and Education of Rio Grande do Norte), UFRN (Federal University of Rio Grande do Norte), *Barreira do Inferno* Launching Center, *Rio de Janeiro* National Observatory, Brazilian Space Agency and NASA – National Aeronautics Space and Administration, besides amateur organizations of astronomy from all over Brazil.

Another relevant fact was the coverage done by the press which publicized our activities and made the event public, giving a great extent to our work. It contributed to many students and the community could make their observations and enjoyed the beauty of the event in the cities visited and in the *Potiguar* coasts.

Looking up the sky is present in all cultures and all myths of mankind.

In the sky, people have already seen gods, mythological figures, geometry instruments and science ones, too. To the skies, prayers are said at the more distinct religions.

So, looking up the sky has provoked the desire and need to better know the events that are associated to the Earth occurrences, such

as, rain, growing crops, droughts, storms and other ones connected to meteorology.

Watching the sky was also seen as a sign of bad foresight. Celestial phenomena as the appearance of comets and eclipses were seen as messages of disgraces linked to demons or to the divine wrath on the men's sins.

Watching the sky also gives us a feeling of beauty and loneliness, because we feel how small our world is, I mean our planet, before the hugeness of the observable universe.

Watching the sky made us feel anxious to see our very planet outside it, and also made us fly like birds, get out of the floor, build aircrafts, surpass the atmosphere and behold the Earth out of it. Stepping the moon and send non-piloted spaceships with artificial eyes to other planets. Thus, we widen our eyes to see the hugely far searching the infinite. We take pictures and film these worlds, galaxies, unknown celestial bodies and impossible to see without widening equipment of visual capacity. So, millions and millions times our vision was widened with instruments which technology has provided.

Watching the sky made us exalt Romanticism, mess up with our mind and heart. So many songs, paintings, poems are done annually related to the Sun, Moon, planets and stars.

Finally, watching the sky makes us feel its inseparable part seeking to know ourselves, the meaning of our existence and it is our eternal search.

Contents

1 THE ASTRONOMICAL JOURNEYS

The sky is our first observatory. The first source of inspiration and learning. The astronomical observations have always enchanted and feared humans along their history. Firstly, with identifications and previews of celestial phenomena, with denominations of stars and constellations allied to myths and beliefs and, after that, with explanations embodied in observations with other instruments besides the eyes, for example, field glasses, binoculars, telescopes and radio telescopes. The astronomical journeys have enchanted the *Potiguar* citizens as a project of scientific advertisement.

In 2009, the whole world was looking at the sky to remember the first telescope observations done by Galileo Galilei for centuries ago in Italy. Thus, many *Potiguar* citizens are having the opportunity to repeat Galileo's deed, too. We are part of a group of teachers and students of IFRN central *campus* who is taking this project to schools of the capital and to the countryside of Rio Grande do Norte. Also, we are engaging students, kids and adults around the celebration of the international year of Astronomy.

The project itself refers to Galileo and his book "Dialogue Concerning the Two Chief World Systems". It talks about a journey, once many actions are carried out every meeting in every visited city.

During the journey, many activities are performed. We aim at teaching how to use instruments such as, field glasses and telescopes, identify planets and constellations, read the symbology of the stars in the national flag, observe the sun with protection filter, know the sun timepiece, the principle of the rocket launching and, above all, socialize the scientific knowledge. We do not intend to solve the lack of existent knowledge in the teaching of science in our state and country, but to contribute to elicit in every citizen, the awareness on the importance of the knowledge that the natural lab, which is the sky, provides us

and that, unfortunately, is very little worked in the school environment. It makes us reflect about the teaching of science, luminous pollution, the environment and other issues which are permeating our activities. This work reaches average 300 people in every city wherever it goes, such as, Carnaúba dos Dantas, Parelhas, Acari, Poço Branco, Parnamirim, João Câmara and Mossoró. These cities were the chosen ones in 2008. In the following year, we visited Caicó, Macau, Santa Cruz and Ceará Mirim. During each visit, several activities were carried out, including a meeting with local teachers after some phone calls made to representatives from the municipal and network of state teachers. We conclude this part making some observations of the sky in public squares with the general population.

During our journeys in 2004 and 2009, we went through 4.310 km visiting 14 countryside cities (besides the activities carried out in our capital city) totaling 167 cities of Rio Grande do Norte besides the capital city Natal. Then, these cities add together a population of 1.752.700 inhabitants, what corresponds to 56,4% of the state population which is 3.107.000 (source: IBGE-2009). In chart 1 below, we present the cities visited in alphabetical order. The cities of Serra Caiada and Currais Novos appear due to we have done some activities which underpinned the journey project.

Chart 1. Cities where we went through

No.	City	Distance from Natal (km)	Population (inhabitants)
01	Acari	200	12.000
02	Caicó	270	64.000
03	Carnaúba dos Dantas	243	7.000
04	Ceará Mirim	34	71.000
05	Currais Novos	172	44.000
06	João Câmara	80	32.000
07	Macau	175	29.000

08	Mossoró	280	245.000
09	Natal	-----	810.000
10	Nova Cruz	90	62.000
11	Parelhas	232	21.000
12	Parnamirim	12	185.000
13	Poço Branco	60	12.700
14	Santa Cruz	115	35.000
15	Serra Caiada	70	8.700
Total		2.155	1.366.400

In the following pages, we present the cities we visited in a chronological order: Serra Caiada, Currais Novos, Parelhas, Carnaúba dos Dantas, Natal (*Bosque das Mangueiras* park), Parnamirim, Poço Branco, Acari, João Câmara, Mossoró, Natal (Natal North Shopping), Caicó, Macau, Santa Cruz, Ceará Mirim and Nova Cruz.

The text below was written by Ana Carolina Mattiuci, a bachelor student of Physics in our school. In this text, she reports the work developed by herself and two more members: Edivânia and Thyago. This work was developed in a parallel course with the other ones we did with the teachers.

1.1 Astronomy for kids

Astronomy has always been an interesting matter which awakened curiosity from everybody. The discoveries about this subject have contributed a lot to the development of science. Then, through it more concrete hypothesis could be shown about, perhaps, the two greatest doubts of mankind: where we came from and where we will go.

Galileo Galilei was one of the great names of the astronomical science and he was one of the defenders of the theory of the heliocentric world four hundred years ago that we know it is true. Besides, he observed the sky and its stars for the first time through a telescope and finds out, for example, that we are not the only ones

who possess a moon. These discoveries reflect even today. So, 2009 was suggested and accepted as the International Year of Astronomy, with some emphasis in the propagation of astronomy for all.

Through the *Norte-Riograndense* Association of Astronomy, which is responsible for a big part of this publicizing in the countryside areas of our state, it has been carried out a project for expanding this propagation suiting it to children, once in the astronomical journeys fulfilled by the Association among the teachers who the lectures were addressed, there were always children, and, consequently, they were not able to understand such debates. So, before this difficulty, a group was created specially to teach astronomy for kids.

The project takes into account the skills kids are able to develop through the ways knowledge is transmitted. That is why the lectures addressed to them are done with posters and play dough which represent the planets, puppet theaters about the stars and their constellations besides a puzzle on the universe and the dynamics of the Moon, Earth and Sun. The language used is not based on math calculus, but in a comparison with the world in which they live, what was a suggestion by the teacher Araújo not to say it, for example, that Jupiter has 142.984 kilometers of equatorial diameter, but to say that it is the biggest planet of the solar system, or that inside it more than a thousand Earths would fit in, or even explain how the stars are born and die, without the help of a deep mathematics knowledge.

This work was already accomplished in three journeys, with the participation of more or less ten kids per journey, what is a small number, but through its dissemination in the city we plan to increase it. Thus, it counts with the participation of three students who had the initiative and were motivated by two more teachers who are also members of the association, and although it has been a work which started because of the international year of astronomy, its goal is to move on in

the following years as well, so that astronomy could be spread increasingly to these little ones who can be, who knows it, future astronomers.

Ana Carolina Mattiuci

1.2 About the work done in the cities

We will mention just down below some particularities of the visited cities and the activities performed by our team, according to the chronological order of visitation, such as: date, place, collaboration, lecture and observation activities.

Rio Grande do Norte is one of the twenty-seven federal units of Brazil. It is located in the northern region and borders the Atlantic Ocean in its North and East, Paraíba in its South, and Ceará in its West. There are 167 cities in an area of 52.796,971 km2, and Its population is about 3.013.740 inhabitants (Source: IBGE- Brazilian Institute of Geography and Statistics). From this total 73% of the population live in urban areas which the most important ones are: Natal, Mossoró, Parnamirim, Caicó, and Macau.

In the national flag, the *Rio Grande do Norte* state is represented by the star l sco (Scorpion Lâmbda) whose name is *Shaula.*

It is one of the smallest states of the federation, a little bit larger than Costa Rica. Natal, its capital has geographical coordinates (5,48° of south latitude and 35,13° of west longitude). It is also the Brazilian state with the biggest projection to the Atlantic Ocean, where its geographical location makes a sharp angle to the Ocean, and because of that it is also named the “The corner of Brazil”. This location motivated the Americans to set up in the *Potiguar* lands an air base during the Second World War and that base was considered a very important spot to the success of the allies and received the name of “*Trampolim da Vitória*”, due to the great jump which it provided to the allies.

Picture 1. Below highlights, in the map of Rio Grande do Norte, the cities where we did the activities which are related to the work of the journeys or sky observation, and such cities are marked with ★.

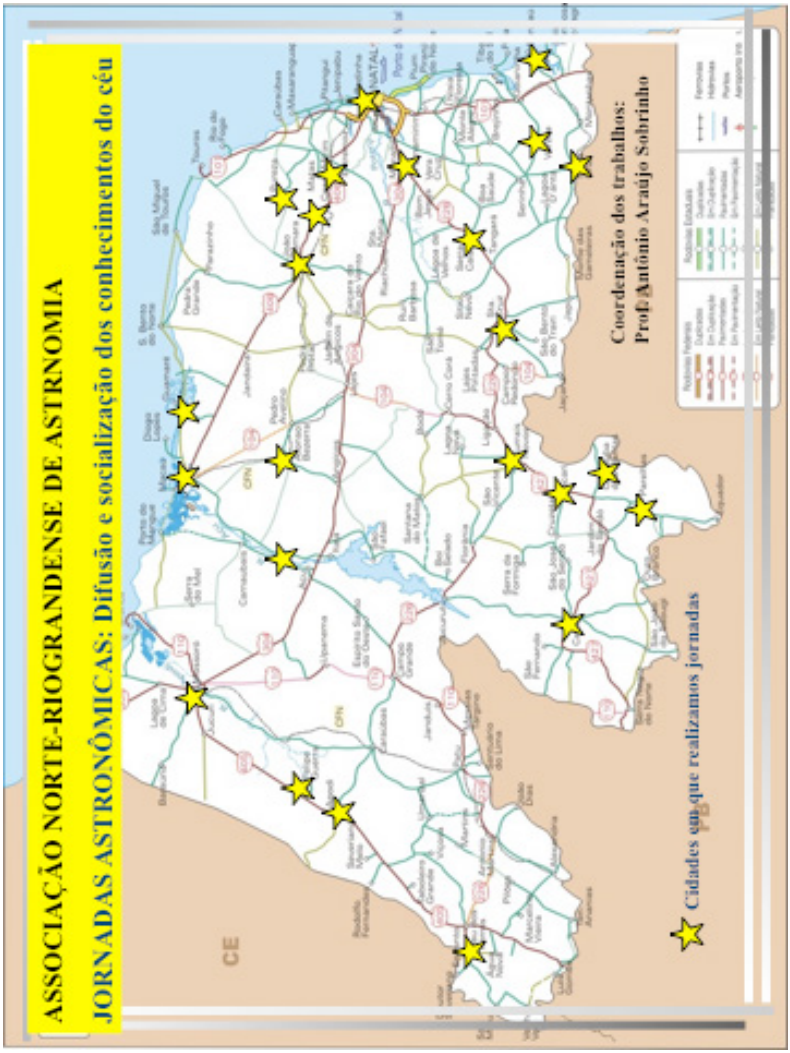


Figura 1. The map of Rio Grande do Norte highlighting the cities where the activities took place.

1.2.1 Serra Caiada

Date: April 17th, 2004.
Workplace: Euclides Lins de Oliveira City School
Local collaboration: Teacher Edrôbledo José da Silva (Edi)
João Maria do Nascimento: Local Secretary of Education.
Dalvaci Serafim de Oliveira: Headmaster of Euclides Lins de Oliveira City School.

In Serra Caiada city, the seed of the Astronomical Journeys was born, an old town from President Juscelino city, now named Serra Caiada, the city where is found the oldest rock in Latin America. The city is located in *Potiguar Agreste* region and was in this small town that we had the warmest welcome among all other visited cities. We worked with teacher Edrôbledo José da Silva (popular known as Edi) and with students from the Teacher Francisco Ivo Cavalcanti State School from Natal in an observation night in which we could see the Moon and Saturn with the naked eye and with the telescope. We did it as a complement of the work we began with Edi and his students. We estimate that at least 2.000 people (more than 20% of the local population) participated of the observations at the night of April 17, 2004. In that moment, we had the illustrious collaboration of a colleague professor Vlac-Lao Hagek (Nick) from Czech Republic who was a visitor professor at the Federal University of Rio Grande do Norte. The next figure shows our participation with students and teachers in Serra Caiada.

Figura 2. Together with the group of students from Francisco Ivo State School (from Natal) in Serra Caiada.

1.2.2. Currais Novos

Data: June 16th, 2006.
Workplace: CEFET-RN, Currais Novos *campus*.
Local collaboration: Teacher Paulo Cavalcanti da Silva Filho.

It is in the *Seridó* Region, 172 km from Natal, in the center of Rio Grande do Norte State and next to the border with Paraíba State is the city of Currais Novos. It has a population of 43.536 inhabitants in a territorial area of 864, 34 km^2.

Currais Novos has already been highlighted in Brazil for its mining activities, with emphasis to Scheelite ore, where it was the biggest exporter of this mineral in Latin America for a long time. Today its main economic activities are based on agriculture, stockbreeding, and in a small scale, the mineral extraction and tourism.

Our works carried out were lectures on the observation of the sky to students and observation of the Moon and the planets Jupiter and Saturn. The activity had the joyful and exciting participation of the teachers besides being a good learning process.

1.2.3. Parelhas

Date: August 12th, 2006.
Workplace: Arnaldo Bezerra City School.
Local collaboration: Lígia Verônica da Silva Sousa and Idelita Roque (Secretary of Education)

Parelhas, a small town in the region of *Seridó*, with a bit more than 22.000 inhabitants was one more seed to our journeys. In Serra Caiada, Parelhas and Carnaúba dos Dantas we had not named yet the title of our work as Astronomical Journeys. However, it was the beginning of our work and because of that we decided to include it as the core of the process that took us to the journeys. We were a reduced group of people, composed of three teachers and two students who were sponsored by an Astronomy Project of CEFET-RN. Teachers: Antônio Araújo Sobrinho, Edrôbledo José da Silva (invited teacher from Francisco Ivo Cavalcanti State school, Natal) and Nanci Barbosa Ferreira Araújo. Students: Dayvid Alisson da Silva Menezes and Lígia Verônica da Silva Souza. We worked in Parelhas in two opportunities, on August 4th and 5th , and on the following weekend, August 11th and 12th .

At the night of August 12th , we tried to observe a meteor shower (*eta aquarídeas*) in the surroundings of *Boqueirão* Dam, one of the local tourist spots, however, the bad meteorological conditions did not provide good observing conditions. The figures 2 and 3 below show our work in the city.

Figura 3. Explanation about the observation of the Sun.

Figura 4. Group of Parelhas teachers

1.2.4. Carnaúba dos Dantas

Date: February 21st , 2008.
Workplace: João Henrique Dantas State school.
Local collaboration:
Mr. Valdenor Euclides de Lima Araújo
Valdenor Euclides de Araújo Júnior
Mrs. Maria José de Carvalho Araújo

Carnaúba dos Dantas is a small city located in the region known as *Seridó* Region by its rock paintings. This characterizes it as an inhabiting place of old people. It has an estimated population of a bit more than 7.000 inhabitants. A great attraction of the city is its religious party which the Passion of Christ is acted in *Monte do Galo*, place of the chapel of *Nossa Senhora das Vitórias*, the city patron saint. The event attracts pilgrims from various regions of the state and neighbor states, too. A famous spot as well is a medieval castle built in the *Caatinga* vegetation and it is two kilometers from local downtown. In this castle, we have made some observations of the Moon and Venus. The culmination was the observation of the total eclipse of the Moon in *Vaqueiro* Square.

Figura 5. Observation of the Moon in Carnaúba dos Dantas Castle.

Figura 6. Rômulo and Marinês.

Night works: *Vaqueiro* square in front of the house where lived the astronomer Rômulo Argtentierre, dead in 1995. In the picture below there is Rômulo and his wife Marines Dantas.

Particularities: In the event, we did a fair honor to Rômulo Argtentierre, and we observed a total eclipse of the Moon with a crowd estimated of 300 people. A curious case is that we got the images of the Moon with the telescope and the crowd followed the event as it was projected on the wall of a water box.

The photo above is the one which contains Rômulo and his wife, Marinês Dantas. The photo below, figure 7, deals with a part of the group who observed the eclipse in Carnaúba with us.

Figura 7. Participants of Carnaúba dos Dantas observing the eclipse of February 21st , 2008, having at their bottoms the projection of the moon on the water box.

1.2.5. Natal - An astronomy night at Bosque

Date: April 12th , 2008
Workplace: Bosque das Mangueiras- Lagoa Nova
Local collaboration: Potiguar University (UNP)

Located on the borders of Potengi River and Reis Magos Fortress, the city of Natal is known as the city of sun, sun fiancée (nickname created by the historian Luis da Câmara Cascudo). It is also called the Space Capital of Brazil for having hold, in its territory, the first base of rocket launching, CLBI – Inferno Barrier Launching Center. At Reis Magos Fortress, it was also observed the first total eclipse of the moon in Brazilian lands. The works were in charge of Georg Marcgraff, German astronomer who was at the service of the Dutch government in 1642 when Natal was called New Amsterdam. At that time, the city was under the Dutch domain and they named the Reis Magos Fortress with the name of Keulen Fort after the Dutch commander troop in Rio Grande do Norte.

The Reis Magos Fortress was also worth mentioning when we conducted the activity: Let's hug the sung". At the time, we spent all night long at the Fortress, observing a total eclipse of the moon when we were waiting for the sunshine, enchanting marvelously the Fortress Beach. The picture below shows a part of the group inside it.

Figura 8. Participants of the program “Let’s hug the Sun”, at Reis Magos Fortress.

The Inferno Barrier Launching Center was also our observation spot from the first to the last total eclipse of Brazil in the twentieth century on March 29th, 2006. At that time, we concluded the cycle of activities of Astronomy in which we had the participation of amateur astronomers and professionals from all parts of Brazil.

The activity which was carried out at Bosque das Mangueiras was part of the schedule linked to the Astronomy International Year in the event which was called A Sidewalk Astronomy. It was an activity which participated people who used the space of the place to go walking and to having fun in the evening. We had a considerable amount of kids, who accompanied their parents, and old people. Some of them said they got astonished because, for the first time, they observed the sky with a telescope. The following pictures show the age rate of the participants, independently of the ages.

Figura 9. Night observation at Bosque das Mangueiras.

Figura 10. Night observation at Bosque das Mangueiras.

Also in Natal, at Ponta Negra beach, our city landmark, we did some observational activities, such as, observation of the eclipse of the Moon and advised the population to observe the total eclipse of the Sun on March, 29th, 2006. In the picture below, there is the ANRA group- Rio Grande do Norte Association of Astronomy, wearing the official t-shirt of the eclipse and the eye-protected glasses donated by NASA- National Aeronautics and Space Administration. In the following figures, we show a part of the group which worked with us in the organization of the Cycle of Astronomical Activities and an artistic conception idealized by Inácio Araújo de Medeiros related to how the eclipse would be observed at Ponta Negra Beach.

Figura 11. The ANRA group “getting prepared” to the 2006 eclipse in Ponta Negra.

Figura 12. Artistic conception of the total eclipse of the Sun at Ponta Negra Beach in 2006.

1.2.6. Parnamirim: President Roosevelt school.

Date: May 10th , 2008.
Workplace: President Roosevelt State School.
Local Collaboration: The school headmaster: Teacher Maria de Lourdes.

Parnamirim, a city joined by Natal, named *Trampolim da Vitória* for having been a war local base for the allied troops of Brazil during the Second World War.

It was built in the city the first planetary center of *Rio Grande do Norte* and it has been given to us a large support to the execution of the observational activities. Besides the astronomical journey in 2008, we participated of other activities, for example, the Environment Week,

with a lecture entitled ‘The environment and astronomy’ and we had paraded in the celebrations of the Motherland Week, alluding to the International Astronomy Year in 2009. Besides the local secretary of education, we had the support of beloved Romildo Faria in the planetarium in Parnamirim. Still talking about the planetarium, we requested to its administration that there should be some honor- making event to Teacher Romildo, naming the planetary after his name.

Figura 13. Night observation at President Roosevelt School.

Figura 14. Part of our group at Parnamiriim Panetarium with beloved Romildo Povoa de Faria.

1.2.7. Poço Branco

Date: June 14th, 2008.
Workplace: José Francisco Filho State School.
Local collaboration:Teacher José Casemiro Felipe; Maria Sônia Pereira Felipe: the school headmaster.

In the small town of Poço Branco, we did several observational works, since the observation of a meteor rain of the José Batista do Rego Pereira Dam to the Astronomical Journey of 2008, in which we celebrated the International Year of Astronomy.

The following figures show a part of our activities around the town.

Figura 15. Presentation of the solar system.

Figura 16. Launching of the didactic rocket at José Francisco Filho School.

1.2.8. Acari

Date: July 12th , 2008
Workplace: Teacher Terezinha de Lourdes Galvão State school.
Local collaboration: Teachers Maria das Graças Baracho and Maria Eunice Baracho.

Acari is a small town with a population of 11.210 inhabitants, located in the popular known *Seridó* Region, 215 km from Natal and famous for being considered the cleanest city in Brazil. It is 270 meters high above sea level and its main tourist attraction is Gargalheiras Dam for its natural beauty, with about 500 meters long. In times of strong rain, the overflow becomes a spectacle of privileged nature with water flowing through the wall forming something like a fiancée's veil.

In the figures, we have illustrated a teamwork and the group who collaborated with us in the Journey.

Figura 17. Explanation on the Sun observation.

Figura 18. the Journey's group in Acari.

1.2.9. João Câmara

Data: August 9th, 2008.
Workplace: City Central square.
Local collaboration:
Teacher Jacques Cousteau da Silva Borges – IFRN, João Câmara campus.

An old city called Baixa-Verde, João Câmara is known nationally for being located in a place which leads the records of seismic shocks in the country. The suffered shocks in the 1980's caused by a succession of quakes with an epicenter in the region of João Câmara spread fear in Rio Grande do Norte. In the area for ten years there were more than sixty thousand seismic movements – some of them imperceptible to the population to those which overcame the magnitude number 5 in the Richter Scale. In the specialists' language, some weaknesses of rocks occur in the zones of the Earth's crust broken in the remote past.

They are called the geological faults, susceptible of new occurrences, depending on factors like the weight carried out on them.

The team who was in João Câmara and the night work are illustrated in the figures 18 and 19.

Figura 19. The Journey team in João Câmara.

Figura 20. Night observation in João Câmara.

1.2.10. Mossoró

Date: September 13th, 2008.
Place: CEFET-RN- Mossoró Campus
Local collaboration:
Teacher Clóvis Costa de Araújo – IFRN headmaster, Mossoró campus.
Teacher Mauriléia Marques Ferreira – Physics teacher at IFRN- Mossoró campus.

A tropical hot and humid weather city, Mossoró is the second most populous town of Rio Grande do Norte, with a population estimated in 275.000 inhabitants. It is considered the capital of the West and the main city of white coast as it is called the salt producer in the State. It is also the biggest oil producer on earth in the country, as well as marine salt. Fruticulture is also highlighted around the town for being an economy source of exportation.

Figura 21. The figure 20 Night observation in Mossoró

The city also deserves some attention due to the honor which it does to one of the great astronomers who was born in Amparo, São Paulo and passed away in the countryside of Rio Grande do Norte. It refers to a bridge entitled Rômulo Argentierre Bridge and that astronomer died in 1996 in the city of Carnaúba dos Dantas.

Mossoró is also known for its culture for being a pioneer in some facts as the first feminine vote and the liberation of slaves before the Golden Law which was promulgated by princess Isabel in 1888. It cannot be forgotten that mossoroenses (people who were born in Mossoró) are very proud for having resisted to Lampião, a famous *cangaceiro**(outlaw, bandit), who with his gang feared the Brazilian northeastern region for a great part of the first half of the twentieth century.

Besides the works in the Journey, we had had a great receptivity from the teachers and students of the State University of Rio Grande do Norte (UERN), whose main office is in Mossoró. Below we have our teamwork in the city.

Figura 22. The teamwork in Mossoró.

1.2.11. Astronomy in the Shopping Center

Date: March 7th, 2009.
Workplace: Norte Shopping Center Parking Lot.
Local collaboration: Shopping Center Marketing Director

The Natal Norte Shopping Center was the first one of the North Zone of Natal with a total area of 60 thousand m2. It was inaugurated on December 6th, 2007 with a free parking lot for one thousand and two hundred cars.

From the Administration, we were given total support for the activities carried out there and we had the presence of a great deal of people.

The shopping Center had been a great contributor in order that many other firms might be able to establish in the region. Some of the participants are shown in the photo below.

Figura 23. Astronomy night at the Shopping Center in Natal North Zone.

1.2.12. Caicó

Date: April 3rd, 2009.
Workplace: Calpúrnia Caldas Amorim State School
Local collaboration: Caubi Ferreira de Souza Júnior – IFRN Headmaster, Caicó campus.
Maria das Graças Rego, Local Education Secretary
Cícero Gomes de Faria, 10th Dired Deputy.

A Semiarid-weathered city and quite hot, Caicó has a population of about 64 thousand inhabitants. It has a main cultural event, the Santana party, whose saint is its patroness. It is a party where *Caicoenses* from many different cities in the State get together to the celebrations. Other local attractions are the Carnival, its typical food and its needlework which are exported to other cities of the State and nationwide.

Our concern with eyes protection is shown in the picture below.

Figura 24. Kids looking at the Sun through welder's glasses.

1.2.13. Natal- Felipe Camarão Neighborhood

Date: April 4th, 2009.
Workplace: Santo Antônio Chapel patio.
Local collaboration:
Flaviano Venturas Vieira
Paula Juliana da Silva

The neighborhood of Felipe Camarão is located in the west zone of Natal. The work itself was part of the program which was called 100 hours of Astronomy and it was within the national program of the international year of Astronomy.

Activities: Moon and Jupiter observation; observation and identification of stars and constellations. Some children who participated in the observations are talking to us about what represents the international year of Astronomy.

Figura 25. Night observation in Felipe Camarão neighborhood in Natal - 100 hours of Astronomy Event.

1.2.14. Macau

Date: May 8th, 2009.
Workplace: Duque de Caxias State School
Local collaboration:
Liznando Fernandes da Costa – IFRN Headmaster, Macau Campus.
Teacher Maria do Rosário Aquino- Secretary of education of Rio Grande do Norte- Macau.

Known for being one of the biggest producers of salt and fish, Macau has a population of 28.000 inhabitants. There, we had one of the best times for the warming reception we had and for the Moon and Jupiter observation together with kids in the public square at night. In the beginning, the sky was full of clouds, however, at night, the sky was clean and we could conclude our works within we had planned to do.

In the pictures, there is our “official rocket launcher”, named José Adriano, launching his water-pressure powered rocket. Our team was in front of the school where our works were done in the afternoon and the observation at night.

Figura 26. The rocket boosted by the pressure of a water jet.
The launching was done in the patio of Duque de Caxias school.

Figura 27. The Journey team in Macau.

Figura 28. The observation work in the public square.

1.2.15. Parnamirim – Participation in the Environment Week in 2009

Figura 29. The Environment Week – June 8th, 2009- Parnamirim.

Figura 30. The Environment Week – June 8th, 2009 – Parnamirim.

We came back to Parnamirim twice in 2009. We were invited by the City Hall Secretary of Education and Planetary administration to present two lectures in the Environment Week, and we conducted the presentation of the solar system in a circus assembled next to the Planetary.

1.2.16. Santa Cruz

Date: August 1st, 2009.
Workplace: Francisco de Assis Ribeiro State School.
Local collaboration:
Teacher Erivan Sales do Amaral – IFRN Headmaster, Santa Cruz campus.
Francisco Antônio Pontes (popular known as Tutu).

Santa Cruz is located in the *Agreste* potiguar region and it has a population of 32.000 inhabitants being 115 kilometers far from the capital of Rio Grande do Norte. As a highlight, locally, it was built the tallest statue in Latin America which is the Santa Rita de Cássia statue, the city patroness. The pictures show the work done with the children.

Figura 31. Kids observing the Sky: care with the eyes protection.

Figura 32. Kids comparing the planets dimensions.

Figura 33. The Moon in the evening. Picture taken in Santa Cruz.

1.2.17. Ceará Mirim

Date: October 16th, 2009.
Workplace: Boca da Mata Enviromental reservoir.
Local collaboration: Maria Soares de Macedo.

Located in the Metropolitan region of Natal and in the mesoregion of the Potiguar East and in the Costa das Dunas Pole, the city of Ceará Mirim had our participation due to the request of Maria Soares de Macedo, who is a public servant at IFRN. Such request served to talk about Astronomy with the group Sea Scooters: Nautical artisans, which Is led by our Dan, Professor Belchior de Oliveira Rocha, and coordinated by Maria Soares.

We could behold the beauty of the night sky in all its splendor, when it was requested the farm lights were turned away. Our work was developed at about 20:00, and was extended to midnight.

In Ceará Mirim, we counted with a happy stay for the intense and catchy participation of the kids in the group through their questioning moments. At the time, we could behold a sky at night, where we observed through naked eyes and with telescope the planet Jupiter and the Galilean Satellites, which are the constellation of Scorpion and Orion. Thus, we identified other stars and talked about the dimension and distances on Astronomy, by presenting the subject: Cosmic vision of the infinite.

Figura 34. The team of artisan nautical Boys and Girls Scouts.

1.2.18. Nova Cruz

Date: October 28th, 2009.
Workplace: IFRN - Nova Cruz campus.
Local collaboration: Teacher Francisco de Assis de Oliveira, IFRN Headmaster IFRN, Nova Cruz campus.
José Domingos Neto
Rosângela Cilene Cavalcanti Silva, Local Secretary of Education.

Located in the borders of *Curimataú* river, the town of Nova Cruz is located in the *Potiguar Agreste* region, being 91 kilometers from Natal and it has a population of 35.000 inhabitants. About an average of 100 people have participated of our activities between teachers and students. The local receptivity let us very much pleased.

Old Nova Cruz, *Urtigal* village, according to historians, for the quantity of existing urticas there. It was also called “Flayed Tapir” due

to some facts which occurred in that place and told by the Historian Manoel Dantas who says: “there was a tapir in these lands with an evil spirit. In a certain day a skillful hunter got to catch the animal in a trap. Anxious to take off the tapir’s spell, the hunter left to flay the animal still alive. But in the first cut, the tapir got to escape leaving behind its skin and getting into the woods” becoming the terror of that place. One is told that a priest named Serafim de Castro would have taken off the animal’s curse. The town of Nova Cruz was founded on March 15th,1852

We had the support of the local City Hall which was represented by the Municipal Education Secretary and they had sent us a bus to drive us to the city and back to where we were, too. Differently from the other cities where we had the participation of IFRN drivers and vehicles.

In the town, we conducted the following activities: Sun observation, launching of the didactic rocket, presentation of the solar system, a lecture on the cosmic vision of the infinite, and night observation. At the night works, we observed the Moon (including photos of our satellite), the planet Jupiter and we carried out observations and identification of some stars and constellations, especially the Scorpion. The following photos were taken during our stay in Nova Cruz.

Figura 35. Participation in the Journey in Nova Cruz – the kids observing the Sun.

Figura 36. Figure 36. The Moon in Nova Cruz.

2. PRESENTED AND DISCUSSED THEMES IN THE JOURNEYS.

Debated themes:

Figura 37. Galileu Galilei

1. Why the international year of astronomy?
2. The Sun observation.
3. Presentation of the solar system.
4. Astronomy through time.
5. A cosmic vision of the infinite.
6. The PET rocket.
7. Astronomy and other fields of knowledge.
8. Some curiosities of Astronomy.
9. The observational work.
10. Astronomical events.

2.1 Why the international year of astronomy?

During our journeys, many activities were conducted. To highlight some, we talked about the international year of Astronomy, a worldwide celebration to Galileo for 400 years of his first observations with instruments and the reflection about what they provided to the scientific development and what changed in mankind from these observations.

The international year of Astronomy in 2009 celebrated the four centuries of the first telescopic observations done by Galileo Galilei in Venice, Italy.

It was a global celebration of Astronomy and its contributions to the human knowledge. In addition, it was given a strong emphasis to

education, to the public engagement and involvement of the young in science through local, national and international activities.

The public interest for the cosmic space had never been so great. So, it contributed to putting the astronomical discoveries in the first pages of the local press.

The international year aimed at meeting demands for information and engagement, not only in 2009, but also in a long term period: educators, artists, scientists, and amateur astronomers in a scientific educational network.

Astronomy is one of the oldest sciences and originated whole fields of Physics and Mathematics.

It also had an important role in the organization of time and space explored by mankind. It provided conceptual tools to Astronautics, to the spectral analysis of light, to nuclear fusion and to the search of elementary particles.

Currently, telescopes in the ground and space collect information in all spheres of the electromagnetic specter, from Gama rays to long radio waves. This instrument had and has had a deep impact to knowledge and is one of the most refined expressions in human intellect.

We had rewritten, just down below, the ONU Resolution that stated in 2009 the International Year of Astronomy 2009.

The General Assembly

Reminding its resolution# 61/185, December 20th, 2006 on the proclamation of the international years, knowing that Astronomy is one of the oldest sciences and it contributed and keeps contributing in an relevant way to the evolution of other sciences and application in many others;

Recognizing that the astronomical observations has deep influences in science, philosophy, culture and conception of the universe.

Noticing that, although there is a generalized interest for Astronomy, it is hard to the public have access to the knowledge of its field;

Being aware that all cultures have developed legends, myths and traditions about the sky, planets and stars, constituting its cultural heritage;

Greeting the resolution 33 C/25, adopted by UNESCO on October 19th , 2005, by viewing the importance of astronomical science to the knowledge and development;

Noticing that IAU has supported the initiative since 2003 and it will act in order that the project have its major impact;

Convinced that the International Year, among other aspects, can have a crucial role in awakening the public awareness about the importance of astronomy to other basic sciences, to a sustainable development through the excitement provoked by astronomy subjects, supporting the formal and informal education in schools and science center stimulating the long-term involvement of young students in the fields of science and technology;

Then, the General Assembly:

1. Decides to state 2009 as the International Year of Astronomy;
2. Designates UNESCO as the leader agency and focal spot to IYA and invites it to organize, within its capacities, activities to be developed during the event, in collaboration with other entities connected to UN, IAU, ESO, astronomical societies and groups spread all over the world, and to this concern, notices that the activities of the event will be cost by voluntary contributions, including the private sector;
3. Encourages all States and organisms of the UN system to enjoy the International Year to promote actions in all levels aiming public awareness of the importance of Astronomy and a wide access to knowledge and astronomical observation.

Figura 38. Teacher Antônio Araújo next to Galileo's bust in the Science museum in Florence, Italy.

2.2. Observation of the Sun

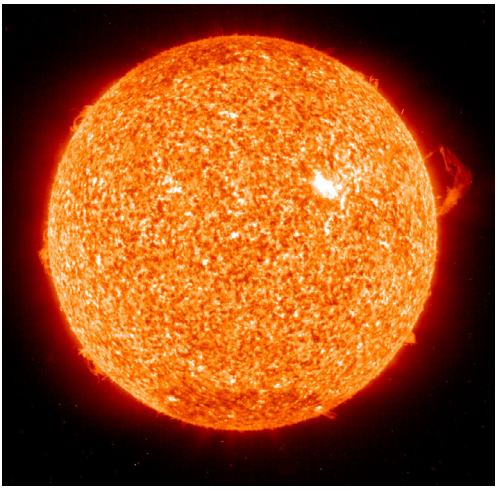


Figura 39. The Sun.

During the day, the Sun is practically the only celestial body visible, however, under certain conditions, it be possible to see the Moon and even rarer, the planet Venus, popularly known as the “D’alva star”. Either with the naked eye, or with instruments, under any hypothesis one should not look up to the Sun. The intensity of its light and the rays emitted are deadly to vision. Special masks and observations done through projections make it possible favorable conditions to its observation. In our observational works, the welder’s glass number 12 was used to our eyes protection.

The Sun is more well explained during the presentation of the Solar System. In its observation, our biggest concern is with the protection of eyes and skin. We have highlighted that the Sun is our closest star, not only the closest, but extremely close when compared to others (more than two hundred and seventy thousand closer than Centaurus Alfa, our first neighbor in the Milky Way- the galaxy which we are part of). So, this proximity makes that, when the Sun comes up in the horizon, in other words, when the day begins, the first solar rays darken the brightness of all celestial stars. We believe that maybe it is one of the reasons that in many cultures and civilizations, the Sun is considered as a God, the Great God. From our side, we do not even know if our ancestors had some knowledge that life in earth depends on the energy of the Sun and that our chemical composition, *id est*, our matter composes itself of products generated in the stars in supernovas explosions.

We also have talked about solar eclipses, the dimension of the Sun and Moon and the necessary conditions to the occurrence of solar and lunar eclipses. It is known that the Moon is the Earth natural satellite, it is much smaller than our planet, and, therefore, smaller than the Sun. So, how can it block its light?

The systematic observation of the Sun along history contributed to the changing of position of its shadow could be used as time measuring.

Thus, the sundial was created. Surely, this way of setting the time was entirely inaccurate because it depended on the not raining and cloudy weather and nothing could be measured after sunset, however, it met the needs of the peoples and time.

2.3 Presentation of the solar system

The solar system is presented by the students quickly (each student presents one of the stars of the system in five minutes) and is open to answer questions after the lectures during the observational works. This part happens at night. Then, the sequence of presentations starts with the Sun and ends with a comet. This way, we have: Sun, Mercury, Venus, Earth, Moon, Mars, Asteroid, Jupiter, Saturn, Uranus, Neptune, Pluto and one comet. in addition, some characteristics of the stars are highlighted, such as: dimensions (volume), comparison with Earth, for example, how many Earths would fit inside the Sun, how many Mars would fit inside the Earth, etc. Average or superficial temperature, rotation period around the axis –day, translation period around the Sun – year (in comparison with the Earth day and year). When the Moon shows up, it states that it is only a natural satellite of the solar system and that there are others. A highlight is done to the rotation movement of the Moon around its axis and its translation around Earth. Soon after, we presented other satellites, which we consider important ones of the solar system, especially the Jovian ones discovered by Galileo.

The table 2 that follows, presents the main data of the solar system, such as: average distance to the Sun, volume, rotation period, translation period, average temperature, number of satellites and mass.

Table 2. Main data of the solar system

Celestial astro	Average distance to the Sun	Volume V_T=1	Rotation	Translation	Temperature (° C)	Number of satellites	Mass (m_T=1)
Sun	-	1,3000,000	25 – 36 d	-	6,000	-	333,000
Mercury	0,4	5%	58,6 d	88 d	224	0	0,055
Venus	0,72	85%	- 243	224,7 d	460	0	0,815
Earth	1,0	1,0	23,56	365,25 d	22	1	1,0
Moon	0,2	2%	27,4 d	27,4 d	-	-	0,012
Mars	1,52	15%	24,15 d	687 d	- 23	2	0,107
Asteroid	2,7	-	-	-	-	-	-
Jupiter	5,2	1408	9,9 h	11,86 a	- 150	63	317,9
Io[2]	-	2%	-	1,8 d	-	-	-
Europe[2]	-	7,1%	-	7,2 d	-	-	-
Ganimede[2]	-	1,4 %	-	3,6 d	-	-	-
Calisto[2]	-	4,3 %	-	16,8 d	-	-	-
Saturn	9,54	843,7	10,45 h	29,46 a	- 180	61	96,2
Uranus	19,2	104,7	17,8 h	88 a	- 210	27	14,6
Neptune	40,06	82,65	16,15 h	165 a	- 220	11	17,2
Pluto 39,44		0,6	- 6,4 d	248 a	- 218	03	0,002
Comet							

[1] Rotation is the movement of the star around its axis. The sun does not have a uniform rotation; it varies from the poles to the equator. The rotation of Venus and Pluto has an opposite direction to the several bodies of system.

[2] Io, Europe, Ganymede and Calisto were the first natural satellites after the Moon to be observed by man. They were discovered by Galileo with his small telescope in 1610.

$\mathbf{D_T}$ refers to the average distance between the Sun and Earth (astronomical unit). We know that this value is not fixed, once the orbits of the planets around the Sun are not circumferences, but eclipses ,and the Sun occupies one of the focus of the ellipse (first Kepler's law).

$\mathbf{V_T}$ refers to the Earth volume.

$\mathbf{M_T}$ refers to the Earth mass.

2.3.1. The Sun

The importance of the study of the Sun has been highlighted and the need of the skin protection, too. Also, it has been emphasized the protection against the solar rays.

Thus, that is the reason the ancient people had a true worship for the Sun. It is the most prominent object in our solar system and it is the biggest and contains approximately 98% of the total mass of the system. So, one hundred and nine Earths would be necessary to cover the Sun disc and, in its interior, it would fit 1,3 million Earths. The visible outer layer of the Sun is called photosphere and has a temperature of 6.000 °C. This layer has a turbulent appearance due to the energetic eruptions that occur there.

The generation of the energy of the Sun (as the normal stars) has just been explained. The explanation came with Einstein's theory of relativity last century. Thus, the energy is generated in the nucleus through the nuclear fusion in which mass turns into energy by the union of two

atoms of hydrogen producing helium. So, in the reaction, the addition of the reagent masses is not equal to the one of the resulting masses. Therefore, the temperature of the solar nucleus reaches 5.000.000 ° C.

The rotation of the Sun is not uniform. It is an immense sphere of gases of plasma with high temperatures and pressure, differences of temperature and currents of convection bring about different rotations between the poles and the equator.

Apparently, the Sun, has been active for 4,6 billion years and has enough fuel to go on for approximately more five billion years. At the end of its life, the Sun will begin to cast helium in heavier elements and will expand itself, finally growing to a so big size that will swallow the Earth.

Despite being much bigger than Moon, it can hide the Sun during an eclipse due to being located much closer from us.

Moreover, knowledge about the Sun has been increasing since space crafts have orbited the star. The first one, was launched in 1959 (Pioneer 5). From this date on, more than a set of ten sounding rockets were sent to orbit and study its structure. In this way, a better comprehension of the Sun is still searched for, and of other stars as well.

2.3.2. Mercury

Mercury is the closest planet to the Sun, it orbits our star at an average distance of 58 million kilometers (equal to 0,38 astronomical units), and it has been known since ancient times. It was baptized as a messenger from the Gods by the Romans, because it was observed that its movement was faster than any other planet. In addition, it is the most intern planet of the solar system and the smallest one. Saturn and Jupiter has bigger moons than Mercury, Titan and Ganymede (one of the moons discovered by Galileo). The other Galilean Jupiter moons Io, Europe and Calisto are basically the same size of Mercury.

The planet has a rotation of 58 Earth days and a translation of 88 days. Thus, a mercurial year equals to 1,5 days of Mercury (while an Earth day equals to 365 days). As a curious thing, a supposed mercurial citizen when turning three years old would be two days. It is an easy observable planet and the most favorable moment is at its elongation. So, at its maximum east elongation, it can be seen at the west sky after sunset and when it is at its maximum west elongation, it is at east, just before sunrise. Just like Venus, Mercury's is interior to the Earth orbit; it can pass forward and still can be seen during daylight hours. Thus, this phenomenon is called planetary traffic.

Mercury has a similar appearance to the Moon, due to its equal land and also by having high number of craters. Practically, there is no atmosphere. Then, the nonexistence of atmosphere has contributed that a great quantity of meteors has reached its surface along time. In addition, as Mercury does not have atmosphere, the thermic amplitude is the highest one in the solar system[1]. Its average temperature is around 167° Celsius.

Since 1974, some unmanned spacecrafts have flown Mercury, the first one called Mariner 10 ran 5,38 million kilometers on March 29th , 1974. So, many recordings and pictures were produced and revealed the solid and dense structure of the planet.

2.3.3. Venus

Venus is the second planet from the Sun. It orbits our star at an average distance of 108 million kilometers, equals to 0,72 astronomical units. Besides, it is popular known as the D'alva star. In Mythology, Venus, the sky jewel, was called the Goddess of love and beauty.

1 In Mercury, due to its proximity to the Sun, the temperature gets up over 400° C during daylight. At night, due to its lack of atmosphere, the temperature falls to – 180 ° C.

The apparent beauty of Venus hides a hostile planet, whose temperature and pressure overcome so much the ones here in Earth. They are 480 ° C , a value higher than the temperatures checked out in Mercury, to the temperature and 90 Earth atmospheres. A dense layer of gases of carbon dioxide brings about a violent greenhouse effect in the planet.

Some Venus particularities are: the temperature, which is the highest in the solar system, the rotation direction opposite to the Earth one and the fact that the day is slower than the year. So, it means that a supposed Venusian would turn one year old before finishing a whole day and the fact this planet presents phases like the Moon. Consequently, a Venusian day has - 243 Earth days.[2]

As a matter of fact, the best way to observe Venus is when it is in its maximum elongation, in the East or West towards the Sun. After the Moon, Venus is the brightest planet in the sky. When it is in maximum East elongation, it can be seen in the evening and when it is maximum West elongation, it appears in the morning sky, before sunrise. Such as Mercury, Venus can only be viewed just after the sunset or just before sunrise. In this way, it can also be seen in daylight when crossing the solar disc, a phenomenon called transit.

Despite being easily visible with the naked eye and telescopes, the visualization of Venus surface cannot be done by optical telescopes because a dense covering of clouds has blocked that Venus could reveal its geologic nature. Thus, with the development of radio telescopes and radar imaging systems obtained by sounding rockets orbiting the planet, it has been possible to see its surface through the level of clouds. Sounding rockets equipped with radars, sent by the old Soviet Union and NASA revealed the nature of the Venusian surface.

2 The negative sign indicates that the rotation direction is opposite to the one of the Earth.

2.3.4. Earth

Earth is our home, the solar system our neighborhood, and the Milky Way our city in the sidereal space. It is the third member from our biggest source of energy, the Sun. It is at an average distance of 150 million kilometers (an astronomical unit). Until now, Earth is the only place in the universe where it is known about life existence.

As a matter of fact, many people dream of travelling through space and see the wonders of the universe. Indeed, all of us are space travelers. So, our spacecraft is the planet Earth, which is travelling to a speed of 108.000 kilometers per hour, orbiting our star. Being 150 million kilometers (astronomical unit) far from the Sun and delaying 365 days and one more fraction which is corrected to have a new day every four years (leap year). So, turning around itself in approximately 24 hours.

The knowledge we have about our planet is not only what we study about the soil, as well as the observation done of the outer space. In this way, as we are on Earth, it seems to be robust and big, and has a radius of 6.380 km (calculated since Ancient times by Eratosthenes), with an ocean interminable by air. From the space, our planet is small and limited. So, the geographical and political borders get lost in the hugeness of the universe. According to Carl Sagan, we are a pallid blue spot, whose life has little time in the cosmic calendar.

On the earth, some interesting words by Sigmund Jahn[3] are relevant to mention.

> These ones who have gone to space returned with a different perspective and worship the planet Earth. The political limits are gone. The limit between nations is gone. We are all a unique people, and every one of us is responsible for keeping the delicate and fragile balance of the

3 Quoted in Astronomy and Astrophysics, Kepler de Sousa Oliveira Filho and Maria de Fátima Oliveira Saraiva.

> Earth. We are their janitors, and we have to take care of it for the future generations.

The quotes by Signmud Janh and the words of Carl Sagan, when they state that “we are a pale blue point”, take us to reflect about our human condition and the responsibility with the future generations, in the search for knowledge and harmony that make sense to our existence.

2.3.5. The Moon

Selene, the queen of the nights. The enchant of the artists: poets and serenader. The Moon, the first known satellite of the solar system, is the first companion of the nights and exerts influence on Earth by the eclipses which provokes when darkens the Sun or for what is provoked on Earth when it is in the shadow of our planet.

Far from us for about 384.000 kilometers, it is The Moon, very dominant at night. When it is full moon, its bright usually obscures the other space bodies. This phase corresponds to the worst moment to the observation of the other celestial bodies, what opposes the common sense.

Still opposing the common sense, the best time to see the Moon with tools it is not in full Moon: in this phase, it reflects light a lot. What makes difficult the crater view. In the phase of a first quarter moon, the details of the mountains and craters are easily observable, even with small instruments.

Presenting the same face to us, the Moon has a synchronized movement of rotation and translation around its axis in 27,4 days. The Moon presents a great thermal amplitude: (varying between – 155 °C (night) to +110 ° C(day).

It is the only place in universe outside Earth, where until now beings, in which human beings stepped the first time on July 21, 1969 for the first time.(Apollo 11 with Neil Armstrong and Edwin Aldrin).

After Neil Armstrong's and Aldrin's deed, other 10 people stepped in the lunar Sun, and collected samples from the soil and samples for studies here in Earth.

The moon presents differently every night. This is because it changes its position relatively in space causing variations in quantity of light which receives from the Sun and reflects to the Earth. Thus, to a better understanding, four lunar phases are pointed out: New Moon, first quarter, Full Moon, and Third quarter. In this way, the explanation of the lunar phases was given correctly by Aristotle.

Only in a New Moon phase, it is possible to have a solar eclipse and only in full Moon, it is possible to have a lunar eclipse. These are moments which can occur the alignments: Sun-Moon- Earth and Sun – Earth- Moon.

2.3.6. Mars

It is the fourth planet from the Sun orbiting our star at an average distance of 228 million kilometers (1,52 AU). It is considered the God of war by the Romans; it is commonly known as the red planet for its reddish coloring has been checked out by observers all over history. As a matter of fact, Mars completes a rotation around its axis every 24 hours and 10 minutes and a translation around the Sun in 687 days. In addition, its average temperature is -55° C and has two small satellites which orbit it: Deimos and Phobos.

It is an easy-viewed planet with the naked eye, its best observation happens when it is in opposition. In Astronomy, it is said it is in the most favorable position to be viewed and it happens because the Earth is between the Sun and Mars. In this condition, the planet is above the horizon during all night. So, the position on August 28th, 2003 was particularly the most favorable in the last 60.000 years.

Thus, many movies feared and enchanted people last century about supposed Martians. This idea that there was life in Mars came

from telescope observations and observers' imagination. Particularly in 1938, when Orson Welles broadcasted a radio series based on the sci-fi classic 'The war of the worlds' by H.G.Wells, many people accepted this story about Martian invaders as a true one and got into panic.

Up to the exploration done by sounding rockets, Mars was considered the best candidate to receive extraterrestrial life. Astronomers thought to see flat lines intersecting its surface and it induced a popular belief that irrigation canals had been built by intelligent beings. Also, another reason that incited scientists to expect life in Mars has to do with apparent color seasonal changes (seasons) in the planet surface.

In Mars, it is located the highest mountain in the solar system, which is the Olympus Mons. The Everest, the highest mountain in Earth, is only a bit higher than a third of the Olympus Mons.

Space ships have flown and even landed in Mars since 1965. The first one was *Mariner*, which explored the planet through photographs. After this ship, several other sounding rockets have explored the red planet.

2.3.7. Asteroid

The asteroids are small metallic rocky bodies orbiting the Sun with reduced masses to classified as planets. The first of them, Ceres, was discovered in 1801. Most of times, its forms are spherical. So, they can be found among the orbits of all planets, however, in the location region is between the orbits of Mars and Jupiter.

Another group of asteroids is located in the Kuiper belt, a region which is beyond Neptune which are called trans-Neptunian objects. Currently, there are more than 20.000 listed asteroids.

They are also known as secondary planets. Their sizes vary from Ceres, which diameter is approximately 1000 km, up to the size of boulders. In addition, they were also found inside the orbit of Earth

and beyond the orbit of Neptune, the Kuiper belt. However, most of them is contained inside a main belt (Asteroid belt) which exists between the orbits of Mars and Jupiter. Some of them have orbits which cross the way to Earth and some even reached Earth in the past.

A lot of our comprehension about asteroids come from examined pieces of space debris that fall in the Earth surface. Asteroids which are in the way to collide with Earth are called meteoroids. So, when a meteoroid strikes our atmosphere at high speed, friction makes that this thick piece of space matter heats in a streak of light known as meteor. If the meteoroid does not heat completely, what is left reaches the surface of Earth and is called meteorite.

2.3.8. Jupiter

It is the fifth planet from the Sun and the larger than the other planets combined. Its average distance from the Sun is 780 million kilometers (equals to 5,2 AU). It is the planet which has the fastest day, completing a rotation around its axis every 9h50min and a translation around the Sun in 12 years.

The temperature in the high clouds of Jupiter is -150° C and, more to its nucleus reaches 20.000 °C.

Jupiter has more than 60 satellites in its orbit, four of them discovered by Galileo and, a fair historical honoring, named Galilean satellites (Io, Europe, Ganymede and Calisto).

Jupiter is a practically gaseous planet with a chemical composition which is equal to a star.

In addition, it is an easily-observable planet: only the Moon and Venus present themselves shiner in the night sky. The best time to see it is when the planet is in opposition – it occurs at least once a year. The next one was in September 2010. In this condition, the Sun shines

totally over it, what makes the planet reach its maximum brightness and it happens only once a year.

Until recently, it was believed that Saturn was the only planet that presented rings, but, in 1979, the space probe *Voyager* found out a thin layer of rings in Jupiter.

Coloring latitudinal bands, atmospheric storms and clouds illustrate the dynamic meteorological system of Jupiter. The formation of clouds change in hours or days. So, the big red spot is a complex storm, moving in clockwise direction. On its outer border, the matter seems to spin from four to six days; next to its center, the movements are small and practically random direction. A set of other smaller storms and whirlpools can form for all cloud bands.

Thus, in the great deep in Jupiter, the pressure is so big that the hydrogen atoms are broken and its electrons are released, so that the resulting atoms consist of simple protons. So, it produces a state in which hydrogen becomes metallic.

2.3.9. Saturn

For many people, Saturn is the nicest celestial body observed through a telescope. It is the sixth planet from the Sun and orbits this star at an average distance of 1,43 billion kilometers (equals to 9,54 AU). It conducts a rotation around its axis in 10 hours and 40 minutes and lingers 29 years and a half to complete a revolution around the Sun.

Such as Jupiter, it is a gaseous giant. It was the first planet where rings were found. So, only last century tenuous rings were found in the other giant planets. Saturn is surrounded by a great number of satellites (more than fifty). Its atmosphere is composed of practically hydrogen and small quantities of helium and methane. At high clouds, the planet temperature is - 160° C.

Saturn is an easily-visible planet (for practically ten months it is in the viewing field of Earth). Also, it is the last visible planet with the naked eye, being known since ancient times. It was the first one where were found rings[4]. The best time to observe it is when the planet is in opposition. And it normally happens yearly, about two weeks more every year. The most favoring oppositions up now happened on January 3rd, 2001 and January 27th, 2006.

The systems of rings[5] of Saturn makes it one of the nicest objects in the solar system. In this way, they are divided in different parts and stretch in space for millions of kilometers along the equator of the planet.

Saturn is a little dense planet, the one with the least density in the solar system. In a hypothetical case of a big enough ocean being found, Saturn would float on it. The cloudy yellow coloring of the Saturn atmosphere is marked by similar large atmospheric bands, but more confusing than the ones found in Jupiter. Sounding rockets have shown that the main rings are really made of a great number of small and narrow rings whose origins are full of mysteries.

2.3.10. Uranus

It is the seventh planet from the Sun. Uranus orbits the Sun at a distance of 2,87 billion kilometers (equals to 19,2 AU), conducts a rotation around its axis in 17 hours and fifty minutes and a translation around the Sun every eighty-four years. If the Earth had this translation period, few people would be over one-year-old.

4 Galileo was the first person to visualize the Saturn rings. He saw them as something diffuse and not identified and classified them as "weird ears" around the planet in 1610. Observations done afterwards by Christian Huygens and Geovanni Cassini showed not only a ring, but a system of rings with several divisions.

5 Jupiter, Uranus and Neptune also present rings, but their view is not easy due to their small thickness. So, only with interstellar probes flying these other planets is possible to observe their weak systems of rings.

Uranus is not easily visible with the naked eye, it is very far from us and that is the reason it is little bright and does not have an easy location. As a matter of fact, it was the first discovered planet with the telescope. Therefore, it was not known in ancient times, although it had been observed and confused with a star of so little brightness in many occasions. So, its discovery was made in 1781 by William Hershel who also in 1782 discovered its two larger satellites. It is known, altogether, 27 satellites in its orbit.

As Jupiter and Saturn, Uranus is composed practically of gases. It has a green color caused by chemical elements which constitute the planet: hydrogen, helium and methane. These two last ones constitute the largest part of the planet. So, in high clouds, the temperature gets to -215° C.

A curiosity about Uranus is that the axis of rotation is tilted sideways, nearly into the plane of its solar orbit. Then, its rotation axis has almost ninety degrees of inclination in relation to its orbital plan. So, during its orbital period of 84 years, alternately, each one of the poles is lighted permanently by the Sun, while the other remains in the shadow. The reason for this inclination are unknown, but it is imagined that during its formation, the planet has collided with another big planet able to produce this abnormal orientation.

Thus, Uranus also presents a system of rings which were discovered in 1977 when the spacecraft Voyager orbited the planet. So, the Uranus rings are distinctively different from the ones in Jupiter and Saturn. A very tenuous distribution of thin dust also seems to be spread along the ring system.

Also, it has an atmosphere relatively dull compared to the other gaseous giants: Jupiter, Saturn and Neptune, which have the highest temperatures in the solar system.

2.3.11. Neptune

The eighth and farthest known planet from the Sun in the solar system. It turns around its axis in 16 hours and 10 minutes and trans-

lates around the Sun in 164 years. Due to a big distance from the Sun, which is more than five billion kilometers, it receives a little energy from the latter and the average temperature in high clouds is - 225° C.

Thus, like other giants, Neptune also has a ring system as well as a big number of satellites. Its ring existence was confirmed by the spacecraft *Voyager 2* in 1989.

Neptune's discovery was made through mathematical calculus. So, astronomers studying its orbit found out disturbances that only would be explained if there was a planet even more distant from the Sun. Then, the characteristics of a supposed planet and the determination of its orbit revealed a high degree of credibility and sophistication of science in the nineteenth century. The Kepler's Laws of the planetary movement and Newton's theory of gravitation described the orbits and the positions of the planets in the sky. John Adams and Urbain Jean-Joseph Le Verrier, independently, interpreted these anomalies like disturbances caused by a planet that had not found yet. So, based on Le Verrier's calculus, the astronomer Johann Gottfried Galle discovered the hypothetical planet in 1846.

Nowadays, with the use of specific computing programs and good equipment, it has become easier to identify and locate objects in the sky and it could not be any different with Neptune.

Neptune's atmosphere is similar to Jupiter's and Saturn's by being basically composed of hydrogen and helium, as well as with the habitual remains of hydrocarbons.

In opposition to the relatively dull atmosphere of Uranus, Neptune's atmosphere is remarkable by its active and visible climatic patterns. Neptune has stronger winds than any other planet in the solar system and they can get to 2100 kilometers per hour; the most violent ones in the solar system. Finally, it was discovered in Neptune a storm similar to the big red spot of Jupiter, but, actually, it is a big dark spot.

2.3.12. Pluto

Pluto was considered the farthest planet in the solar system. Its discovery was made in 1930 by Clyde Tombaugh when examining a photographic plate of a space region, where he believed it would exist some object to disturb Neptune's orbit.

So, a question is still done: why is not Pluto considered a planet anymore?

The need to define what is necessary to be a planet was created by technological advances which allow astronomers to observe more distant areas of the universe and measure more accurately the size of celestial bodies of the solar system. Thus, in 2006, the International Astronomical Union created a new category of planets, the dwarf planets – and Pluto was the first one of this new class of solar system objects.

Pluto has a mass that is inferior to 20% of the mass of our satellite, the Moon, what becomes that star not only much smaller than any other planet, but also with mass and dimensions much smaller than at least seven satellites of our solar system. On the other hand, Pluto has twice the diameter (and twelve times the mass) of Ceres, in the asteroid belt, and was the larger known object in the Kuiper belt[6] until the discovery of Eris in 2005.

In this way, Pluto, as well as Venus, has a contrary rotation to the other planets which orbit the Sun. Its rotation has a period of - 6,4 days (direction of rotation which is contrary to the movement of Earth rotation) and its average distance from the Sun is 5,9 billion kilometers. Due to this distance, it executes a translation around the Sun in far 248 years and its temperature is - 235° C. So, the eccentricity of its orbit makes it close to the Sun at certain times more than Neptune.

6 Kuiper belt is a region in space beyond the orbit of Neptune, where the transneptunian objects are located.

By the way, the physical characteristics of Pluto are mostly unknown for the dwarf planet has not received yet a spaceship and the distance from Earth makes difficult more detailed investigations.

A spaceship launched by NASA (New Horizons) in 2005 will study Pluto and it might orbit it in 2014.

2.3.13. The comets

The comets constitute another set of small bodies orbiting the solar system. Their orbits are very elongated ellipsis. They are very small and weak to be seen even with a telescope, unless they approach the Sun. In these occasions, they develop brilliant tails that, sometimes, can be seen with the naked eye. They are made up of mixture of ice and dust, like a dirty ice ball, according to model proposed by Fred Lawrence Whipple (1906 - 2004) in 1950. As soon as they approach the Sun, some part of the ice melts forming a big cloud of gas and dust around the comet called coma, with a diameter of around 100 thousand kilometers. The solid and icy part in its interior is the nucleus and usually has from 1 to 10 kilometers of diameter. The heat and solar wind originated from the Sun blow the gas and dust from coma forming the tail. This tail always points in the opposite direction to the Sun's and can elongate until 1 AU length. Currently, it is believed that comets are primitive bodies, presumably remainders of the formation of the solar system which created by the collapse of a huge molecular cloud. These bodies would form a vast cloud surrounding the solar system in orbits with aphelion in approximately fifty thousand astronomical units from the Sun: the "Oort cloud". There would be something around 100 billion cometary nuclei in this cloud. Eventually, the gravitational interaction with a close star would disturb the orbit of a comet making it being launched to the inner parts in the solar system. Once the comet is turned aside to the inner part of the solar system, it does not survive

more than one thousand perihelion[7] passage before losing all its volatile elements. In July 1994, a comet named Shoemaker-Levy 9, which had broken itself in more than 21 pieces and the biggest ones were 1 km long, collided with Jupiter, blowing up in the ammonia clouds in the Jupiter atmosphere.

The mentioned comets are the most known or recently the most viewed going through the sky of Earth. Halley, Hale-Bopp, Hyakutake, West, Biela, Shoemaker-Levy, Koroutek and Lulin. It is relevant to say that a comet usually gets its founder(s) names, a just honor.

2.4. Astronomy through time

The astronomy through time makes a brief historic report by the science of evolution that has contributed so much to the change in our concepts of space and time. How the sky was seen by various cultures and how the observational instruments get to a point of sophistication that allow us, not only to view what is possible to visualize through optical sensors, as well other bands of the electromagnetic spectrum which are inaccessible to the optical observation.

The concept of time is indicated by pauses or duration periods of a specific event.

Some very old questions:

How to set the passage of time?

Why does the year have 365 days?

When the watch did not exist, how was time measured?

Is the Earth the center of the universe?

Is the Sun the center of the universe?

Is the universe finite or infinite?

7 In astronomy, perihelion is the less distant point between a star and the Sun.

Figura 40. The watch - nowadays the most common time setters.

It's amazing the interest people feel about the sky. Who has never admired the sunset or got impressed with a storm? However, even today, the celestial and atmospheric phenomena which are part of our day-by-day life are not understood by a great majority of people.

Pre-history involves a period of time of one hundred thousand years ago to about eight thousand years before Christ. In the pre-history time, the human being used to live in small nomad groups. So, the concern with survival in a natural and hostile environment was a crucial one. Hunting, fishing, searching for fruits and crops, running away of dangerous animals and protecting from climatic variations were part of the pre-historic man's daily life. Then, the man at that time had to adapt to the alternation of the clear-dark sky and the change of seasons.

Surely, the Sun was the first star to be noticed. The reasons are clear: The Sun provides the most evident alternation of clear-dark to us. Thus, the Moon was the second star to be noticed, once it lights up darkness at night, technically in its full phase. The stars should be noticed afterwards like shining dots contrasting to a quite dark sky.

There are rupestrian drawings (inscribed in rocks) that include star figures. Both stars and animals, the mountains, forests, deserts, and water were considered divinities because they were not wholly understood.

Also, it still occurs the mythicization of the natural phenomena being associated to divinities.

In the beginning, we used to count stars. We were limited by the reach of our eyes, that is to say, the world finished where our eyes could reach.

So, the stars always guided our forefathers in their navigation, and in agriculture. In several cultures were created calendars to determine better dates to hunting, fishing, rain periods, growing crops, and the harvest. Thus, parties were organized to celebrate abundance of food and religious ceremonies. It was believed, as many people still do, that the position of the stars in the sky has some influence in the fate of mankind. It is known, however, that humans are connected to the stars and this bond is not personalized. The ignorance, though, persists in many people and astrology is still a great source of exploration of the humanity for they have interest in horoscopes, fakes superstitions, card games, numerology without worrying with scientific basis. It is proved that, even today, there are peoples who get frightened with astronomical events like the eclipses and comets.

For this reason, the calendar came up from the systematic observation of the sky and regularities checked out in certain stars, for example: the sunrise and sunset and the Moon phases. As time goes by, humans learned to forecast certain events as the eclipses and the appearance of comets.

It was easily observed the movement of the stars in the night sky, always rising in one side of the sky (currently named East) and disappearing in the West side. However, some “stars” (totally five) presented a different movement. So, they were called wandering stars (original meaning of the word planet, from Greek origin) which were visible to

the naked eye and could only be noticed when the observation of the sky became persistent every night. This type of nature investigation had already needed some persistence and patience by people's ancestors.

The oldest and remarkable civilization came up in the regions of the basin of the rivers Tigris and Euphrates (Mesopotamia, current region of Iran and Iraq), around 3500 B.C., uniting various well-structured cities. One of the state-cities was the Babylon, whose supremacy lasted for about 300 years. Thus, the Babylonians were one of the first peoples to register the presence of the five planets visible to the naked eye (Mercury, Venus, Mars, Jupiter, and Saturn). The gods, heroes and animals which belonged to these people were associated to the observed stars, coming up the oldest shape of week, for each day was linked to one known star (considered as being gods).

The Babylonians constructed the oldest calendars. They comprise 12 lunar months (divided in four weeks), 29 or 30 days each one, whose beginning is marked by the appearance of the new Moon.

The systematic observation of the dislocation of the Sun in the sky allowed man to realize some remarkable facts:

1. Both the sunrise and the sunset do not occur daily in the same places in the horizon circle;
2. The duration of this dislocation is different day after day. The most incredible thing was to notice that these facts occur cyclically;
3. The first measurements of time were made to long periods (months and years) and not to short breaks (days and hours).
4. The persistent observation of the change in the Moon aspect made possible that the lapse of time between two equal and successive phases correspond to the period of 29 and 30 days. So, this lunar period is called lunation. The concept of month came from this astronomical fact.

Other civilizations as the Egyptians, Greek, Mayans, and Incans in America also created calendars based on astronomical observations. Thus, they set time for parties, rituals and cultivation.

By the systematic observation and, perhaps, by the limitation of our eyes or by mythological and religious questions, humans believed to be in the center of the universe. In perfect spheres of crystals, the stars were stuck and the planets going on circular immutable movements in time. Mankind adopted it as a dogma and source of domination for a long time. In addition, contrasting opinions coexisted as well, but, they were not dominant and ridiculous in the scientific fields for a great part of our history, as the theory that stated the Sun, not Earth, was the center of the universe. The first theory was known as the geocentric model, while the second, the heliocentric one. According to the understanding of that time, the universe finished where our view could reach, in other words, in the field of the stars.

Figura 41. The crib of the West science is in Greek. “In the picture we have the Parthenon in Acropolis, Athens, the house of Gods”, beholding place and philosophical studies.

The improvement of the observation instruments in the sky, connected to more judicious observations allowed mankind to conclude that neither the Earth, nor the Sun, can be considered the center of the universe.

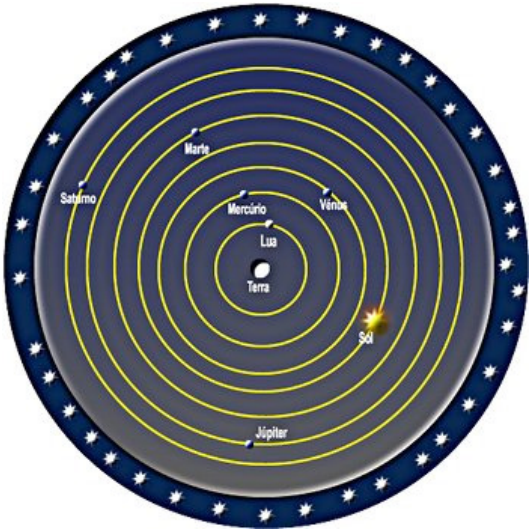


Figura 42. Representation in two dimensions of the geocentric model. In this picture, the last planet is Saturn, the last one visible without instruments.

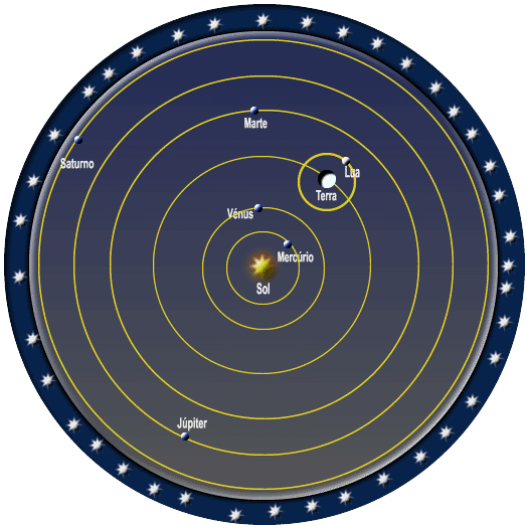


Figura 43. Representation in two dimensions of the heliocentric model. In this picture, the last planet is Saturn, the last one visible without a telescope

Figura 44. In Venice, Italy, Galileo made the first observations of the sky with a telescope.

Figura 45. In the city of Pisa, Italy, Galileo carried out several scientific experiments. In this picture, the famous leaning tower of Pisa. In Italian: *La torre pendente*.

In accordance with the most accepted scientific theory nowadays, the big bang, we live in an expansion universe. According to it, each place in the universe views the others as they were getting away and, as far as we are, higher is the separation speed. In this way, each planet, each galaxy observes same symmetry, that is to say, same homogeneity, being the center considered. If we used to count stars in the past, today, we count galaxies, supernovas, quasars, black holes, invisible radiations and, even though, we still conclude that the universe is very unknown to us. Then, we are limited by what we observe and feel, and by the science limitations as well.

2.5. A cosmic view of the infinite

We have talked about some questions of observational order in this lecture which makes us reflect on our conditions in the cosmos hugeness, such as the planets size, the comparison between planets and stars and distances in Astronomy.

2.5.1. Some fundamental questions

1. What is our dimension in the cosmos?
2. How big is the Earth?
3. How big is the Sun?
4. Is the Earth really big?
5. Is the Sun really big?
6. But, is the Sun really big?
7. How is it possible to calculate distances in Astronomy?
8. How long would it take to reach Centaurus Alfa, the closest star in our solar system, with the most advanced technology nowadays?
9. Is the universe finite or infinite?

Through this lecture, we aimed at reflecting on our dimensions and distances on Astronomy. We began with a comparison between the Sun and the other planets, including the dwarf planet Pluto. Surely that the biggest concern here is to highlight the dimensions of the Earth before the Sun and other planets. Thus, the debated information has the purpose of relating the volumes between the stars, coming up with an idea of the dimension of these bodies.

In this way, we know the distances among cities, states in a same country and several countries. We also spoke about the difficulties of our forefathers with regard to the distances to be gone through by sea or land. So, we live in a world where hurry makes us travel long distances in a short amount of time. In old times, our planet was considered a huge one for the difficulties of the means of transportation (animals, boats and our own muscles). We do not hold back to explain how these dimensions were determined, we only presented them. However, some explanations are necessary about the astronomical distances, like for example, the determination of the Earth radius and its volume.

Along history, scientists always had difficulties in expressing huge distances which separate the celestial bodies and the extraordinarily huge dimensions of the known universe. Then, the units 1m, 1km etc., usually employed, showed themselves inadequate to translate uncommon distances.

Once the speed of light is set and as the distance is equal to the speed multiplied by the time, a new measure unit to distances is created, the light-year. So, the light-year is not a unit measurement of time, but a distance one. But how distant? It represents the distance that light travels in a year. The own speed of light is extremely superior to everything we see moving day-by-day and it is not easy to measure it. It is not our purpose here to detail the facts that reach its result. Nowadays we know that speed of light in vacuum is 300.000 km/s. With this value, we can calculate how much it represents in kilometers.

So, the calculi are:
V = 300.000 km/s
T = 1 year = 365 days x 24 hours x 60 minutes x 60 seconds
T = 31.557.600 seconds
As $d = v\,x\,t$

So, d = 300.000 km/s x 31.557.600 s = 9.467.280.000.000 km
d = ≅9,47 trillion kilometers

Nothing is comparable to this value here in Earth.

As a source of information, the closest star in our Sun (Alpha Centauri one of the guards of the Southern Cross) is found at a distance of 4,3 light-years (something around 40 trillion kilometers).

The dimension here in Earth served as a basis to the standard definition of distance (meter) for a long time. But, how is the Earth radius determined? It is about Eratosthenes' genial idea, in Egypt, using a simple mathematics reasoning of measuring distances in space.

2.5.2. The measurement of the Earth radius

Eratosthenes lived in Egypt between 276 and 194 before Christ. He was a chief-librarian of the famous library of Alexandria and he found there an old papyrus which showed that at noon of every June 21, in city of Syene, 800 km to the South of Alexandria, a vertical rod in the soil did not produce any shadows.

A useless culture, some people would say, but not to a great observer as Eratosthenes, because he noticed that the same phenomenon did not occur in the same time and day in Alexandria and he thought:

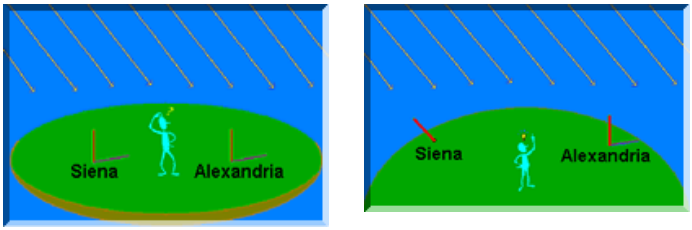


Figura 46. If the world is flat as a table, so the shadows of the rod have to be the same. If that does not happen it is because Earth must be bent.

More than that for the more curved was the surface of Earth, the more different the length of the shadows would be. So, the Sun should be so far away that its light rays reach Earth in a parallel form.

Thus, some rods put vertically in the soil in different places would launch shadows of different lengths. In this way, Eratosthenes decided to make an experiment by measuring the length of shadow in Alexandria at noon in June 21 when the rod did not produce any shadows in Syene. Therefore, he obtained the angle A, according to the figure down below:

Representation of the solar rays over the Earth Length of shadow

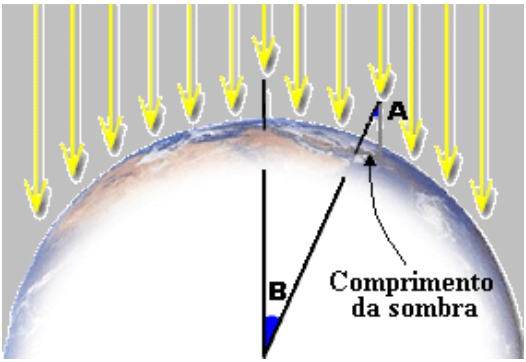
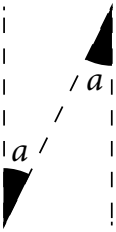


Figura 47. A representation of the experience idealized by Eratosthenes.

Eratosthenes measured A = 7° (approximately). If the rods are vertical, it can be imagined that if they were long enough, they would

meet in the center of Earth. Then, pay attention to the figure above. It shows that the angle B will have the same value as A, for Eratosthenes' picture is reduced to a very simple geometry: if two parallel straight lines intercept a transversal one, so the corresponding angles are alike.



The parallel straight lines are the light rays of the Sun and the transversal line is the one which passes through the Earth center and rod in Alexandria.

As a matter of fact, Eratosthenes knew that this distance would be 800 km and then he thought: 7°= ~ 1/50 of circumference (360°) and it corresponds to about 800 km.

So, eight hundred kilometers times fifty equals **forty thousand kilometers**, so this must be the value of Earth's circumference[8].

The value found nowadays is around 40.072 km along the equator. A very little mistake for a very simple measurement done a long time ago. In this way, with the circumference, we can calculate the diameter and the radius or even the volume and area of the surface through simple formulas.

$C = 2 \pi R^3$
$V = 4/3 \pi R$
$A = 4 \pi R^3$

The knowledge used by Eratosthenes (parallel straight lines cut by a transversal one) is formally seen in the geometry classes in Middle school.

2.5.3. The distance from Earth to the Moon

One of the greatest Greek astronomers was Hipparchus (190-120 BC). Among his contributions are the bases of trigonometry. By

8 For more details, see http:www.zenite.nu – How to measure distances in space: José Roberto de Vasconcelos Costa.

using Geometry, he formed an idea, in an apparent simple way, to the determination of the distance between the Earth and Moon. His Geometry was applied during the observation of a lunar eclipse and the calculated distance was based on the Earth radius. In this way, the accuracy of Hipparchus' calculus was not very good, but his theory opened up ways to new ideas and improvements of the measurements. [9]

To measure the distance from Earth to the Moon, Hipparchus did not need the same radius' Earth, because he imagined a geometry that during a lunar eclipse (when Earth is exactly between the Sun and Moon) would be possible to calculate the distance from Earth to Moon.

2.5.4. The distance from Earth to the Sun[10]

Earlier than Galileo and Copernicus, Aristarchus of Samos (310-230 B.C.), who lived in ancient Greece, believed that Earth moved around the Sun and studied how to measure its distance and the size of the Moon.

In the same time of Eratosthenes, he used an elegant and quite simple geometry to measure the distance from Earth to the Sun, once he already knew the distance from Earth to the Moon. Thus, it makes us wonder how much ancient wisdom was lost along history.

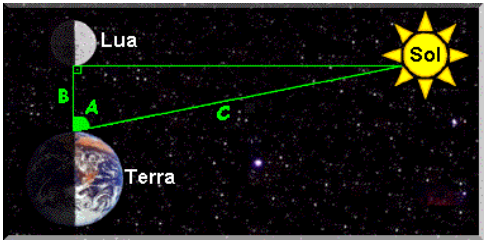


Figura 48. Elementary trigonometry to calculate the distance from Earth to the Sun.

9 For more details, see http:www.zenite.nu – How to measure distances in space: José Roberto de Vasconcelos Costa.

10 The distance from Earth to the Sun is named Astronomical Unit and works as a standard to the distances of the stars in the solar system.

Surely that such simplifications impose some limitations to the result. However, the biggest challenge here is to know the exact moment of the Moon in first or last quarter in order that the angle A reflects at least an approximate result.

Thus, the Kepler law and the Newton's one of the universal gravitation allowed to determine with a very good accuracy the distances within the solar system, having allowed as well the discovery of the planet Neptune before its optical observation. The thing is that the orbit of Uranus disagreed with the observations, so to correct its position in the sky was necessary the existence of another planet that exerted gravitational influence over it. Then, the data of this planet were calculated and at a later stage were made some observations that confirmed the calculi.

2.6. For bigger distances - Parallax

In astronomy, the stellar parallax is used to measure the star distances using the motion of Earth in its orbit.

Parallax comes from Greek and means alteration. So, it is the alteration of the angular position of two relative stationary points with one another as seen by an observer in motion. In a simple way, parallax is the apparent alteration of an object against a background due to the observer's motion.

Once the physical quantities used here in Earth are not appropriate to the astronomical distances, new units of measurement to space distances were created, as well as different methods to measure were used. In this way, the astronomical unit was created, which is the average distance between the Earth and Sun. Then, the light-year and parsec is the distance so that the annual parallax is one arcsecond or arcseg. So, a parsec equals to 3,26 light-years.

Moreover, the parallax method allows a better precision in the measurement of the distance between the Earth and Moon and besides

estimating the distance between the relative close stars (something around 100 light-years). Then, to even bigger distances (most part) other methods are used, such as standard candles and supernovas, however, it is not our concern to discuss this topic here.

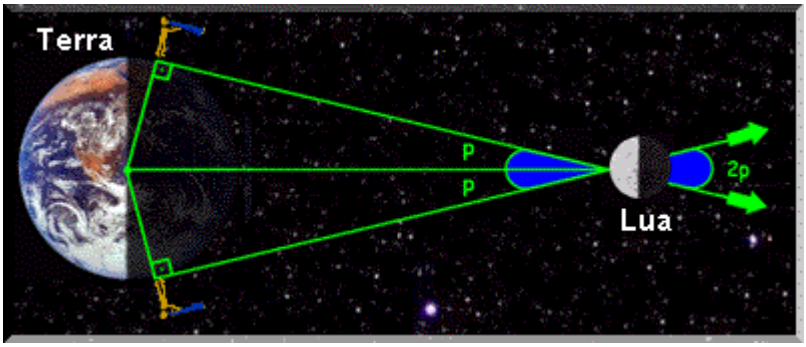


Figura 49. Parallax method applied to the measurement of distances: Earth-Moon.

2.7. Some comparisons

To make things simple, of all the several measurements that characterize physically a celestial body, we are going to use only the equatorial diameter.

Thus, the smallest of the celestial bodies depicted here is Pluto whose diameter in the Equator is 2306 km. So, the Earth where we dwell is almost six times bigger, with around 12756 km. But, this is little, because our Sun has a diameter of 1.392.000 km, in other words, it is almost 110 times bigger than our little blue planet.

Surely you must be thinking it is big, is not it?

Antares, which appears in the last picture, is a red giant star which is in the Scorpion constellation and it is estimated that its size be 700 times our “little Sun”. The former should measure more or less 974.400.000 km of diameter.

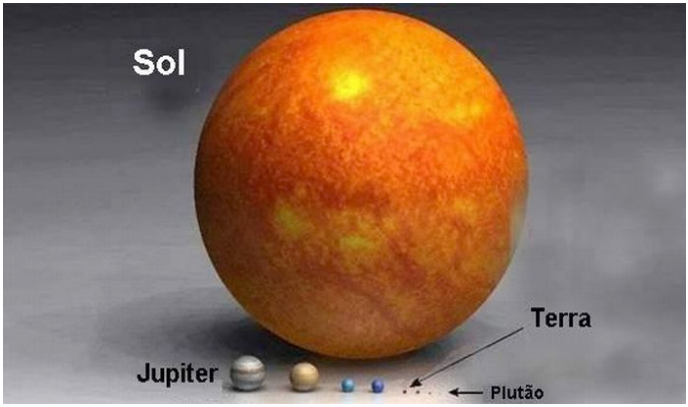


Figura 50. Comparison of volume of the Sun with the planets, including the dwarf planet Pluto.

By the figure above, it is possible to estimate the volume of the Sun and compare it with the planets in the solar system. So, the figure is not in scale distances. It is possible to see our little planet Earth and compare it with other planets.

By analyzing the figure, the Sun is much bigger than all planets together. Our Earth is much inferior to the Earth, Jupiter, Saturn, Uranus and Neptune.

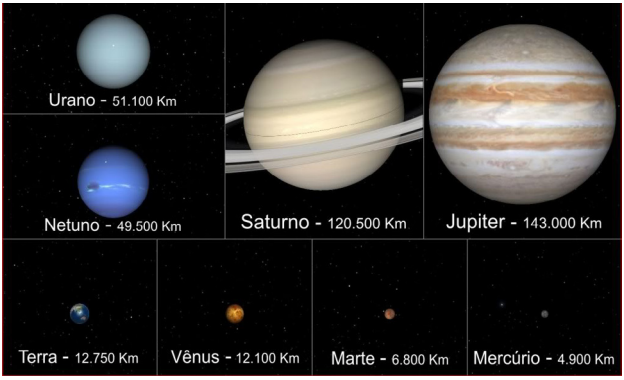


Figura 51. In this figure are depicted only the planets with their respective diameters.

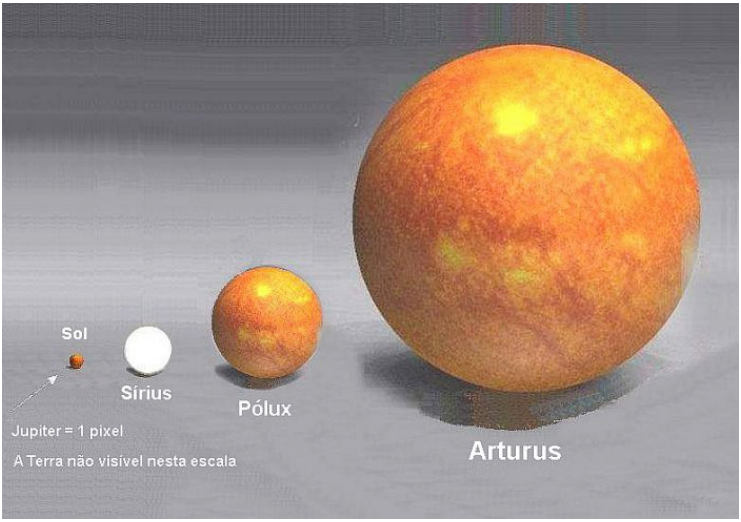


Figura 52. A comparison between the Sun and other stars of the Milky-Way.

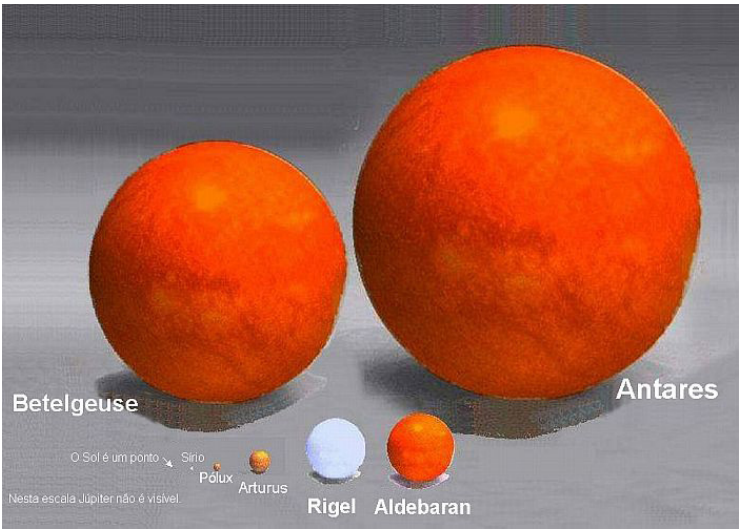


Figura 53. A new comparison between the Sun and other stars of the Milky-Way. The Sun is almost imperceptible.

This assemblage allows to compare the size of the planet Earth with the other planets of the solar system, the Sun, and other suns or stars. So, this is a good way to have knowledge of our insignificance, for the several stars depicted here have size differences that come to be incomprehensible to the ordinary human being who is not an expert on astronomy.

The stars and suns that appear in the figures shown previously whose respective constellations are:

Aldebaran- Alpha Tauri- the brightest star in the Taurus constellation.
Antares- Alpha Scorpii- it represents the State of Piauí in the Brazilian Flag.
Arcturus-Alpha Boötis- the fourth bright star in the firmament.
Betelgeuse (Alpha Orionis) and **Rigel** (Beta Orionis) are the two biggest stars in the Orion constellation.
Pollux or **Beta Geminorum**- the brightest star in the constellation of Gemini.
Sirius or Sirius is the brightest star in the night sky. It is located in the constellation of Canis Major and can be seen at any point of the planet Earth.

2.8. Some calculi to estimate distances in the universe

The table 3 below shows a relation of distances in astronomy:

	Distance (km)	Distance (light-year)
Earth diameter	12.756	insignificant
Earth-Moon	380.000	insignificant
Sun diameter	1.390.000	insignificant
Earth-Sun	150.000.000	insignificant
Sun- Alpha Centauri	$4x\ 10^{13}$	4,3
Milky Way- Andromeda	$1,9 \times 10^{20}$	2.000.000

Table 3- Some distances in Astronomy.

How long does it last a trip to Alpha Centauri, our closest star?

Starting data: Distance in light-year: 4,3
Speed of light in vacuum: 300.000 km/s
1 year: 365, 25 days
1 day: 24 hours
1 hour: 60 minutes
1 minute: 60 seconds

Calculus of the distance in kilometers

D = 4,3 years x 365, 25 days x 24 hours x 60 minutes x 60 seconds x 300 000 kilometers per second

D = 40.709.304.000.000 km = 40,7 trillion kilometers.

If we could travel in the speed of light (300.000 kilometers per second), our trip would last 4,3 years, however the fastest ship launched by men[11] came to develop the amazing speed of 100.000 km/h.

If we could travel in this speed and never stopped to get gas, without any unexpected situation or failure then:

$$V = d/t \Rightarrow T = d/v$$

In hours, we have:

$$T = \frac{40.709.304.000.000 \text{ km}}{100.000 \text{ km/s}} = 407.093.040 \text{ hours}$$

In years, this time would be…

11 The spaceship New Horizons launched by NASA on January, 19, 2006 had the mission to explore the dwarf planet Pluto and its satellites.

$$t = \frac{407.096.040}{365{,}25 \times 24} \quad h = 46.440 \text{ years}$$

46.440 years- Do you think it is little?

And to our closest galaxy, Andromeda?

It is 2.000.000 light-years.

And to the farthest star?....

2.9. the PET rocket

The word rocket is applied to an engine that boosts a vehicle, expelling combustion gases by burners located in its rear part. The first news about the use of rockets date back to China in 1232, where powder was invented. In Europe, the rockets were introduced by the Arabs.

The basic principle of working of rockets is Newton's third Law – for each action there is an equal and opposite reaction. In the rocket when the burnt gases run away in a strong thrust through a compressed nozzle. In this way, the device is propelled in the opposite direction. So, the magnitude of the thrust depends on the mass and speed of the expelled gases.

At the end of the nineteenth century and in the beginning of the twentieth century, the first scientists came up that saw in the rocket a system to boost vehicles which could win terrestrial gravity could reach other stars. Among them, the following scientists are worth mentioning: Konstantin Tsiolkovsky (in Russia), Hermann Oberth (In Germany), and Robert Goddard (in the US). Afterwards, others came up and gave some boost to the production of rockets: Sergei Korolev (Russia) and Werher Von Braun(Germany).

Initially, as well as today, the rockets were used specifically to military purposes. Particularly, the rockets used in the space program of

the old Soviet Union were originated from R7, a ballistic missile, which was used to launch the Sputnik missions.

In our case, we used the PET rocket which is run on water and compressed air inside a refrigerant container activated by a hand-air pump. Thus, the working principle is the same of the big launchers of satellites, but what people learn and have fun with it makes the activity be enjoyed by all participants of the journeys.

As a matter of fact, we had a big concern with the safety of the participants, for this activity was done outdoors and despite the little mass of our vehicle, some variables were observed aiming to avoid accidents with the observers. So, we observed: height, reach, speed of the wind among other things, at the same time we discussed an application of Newton's third Law.

3. ASTRONOMY AND OTHER AREAS OF KNOWLEDGE

Astronomy is not only the oldest natural sciences. It is also the one which relates more with the other areas of human knowledge. Thus, it has had a companionship not so harmonious with history, geography, physics, mathematics, besides arts and music. So, in other words: geography delimits the positions on Earth from meridians and parallels, which are imaginary lines on the globe: latitude and longitude. In our location, we mention the address where the street, neighborhood, city and country are identified. So, in Astronomy we locate objects by space coordinates, such as azimuth and height.[12] The question is that height is determined by an angle and this one is a mathematical creation. Also from math, we use models to explain the universe, for example, there are geometry models to characterize the trajectories described by celestial bodies and mathematical equations which allow to make forecasts of space and time location to planets and comets, among other things. Otherwise, chemistry gives us support in the study of formation of chemical elements in the stars. From math, we still use equations which based Kepler's and Newton's Laws and Einstein's theory of gravitation.

Moreover, about math it is worth mentioning one of Galileo's statement…

> "The book of nature is written in mathematical language"

In history, literature, arts, music, poetry, which are also expressions of wisdom and human culture, we observe the complex relations among these areas of knowledge with Astronomy. As the sky has also been a source of inspiration to many poetries and songs, we aim at exploring these artistic manifestations through questionings about the meaning of cited words in the lyrics of songs and poetries. Then, we

12 In Astronomy, height is a nomination for the location of celestial objects.

believe this interaction not only collaborates in the knowledge of cosmos, but also makes explicit the relation among these areas.

In our trips, we worried about working with teachers and students of any kinds of subjects: learning and studying with them, so we could finish our planned activities for we see that a broken off teaching or an isolated way of teaching each subject causes some difficulties for learning. However, it is facilitated when the educational work is planned based on the exploration of multidisciplinary features that Astronomy provides.

In this way, the work we also did in the public squares makes us believe that it is not necessary a big mathematical serious study to know and get enchanted by the beauties which the sky gives us every day and night.

4. SOME CURIOSITIES ON ASTRONOMY

In music, arts, popular imaginary, history, geography, chemistry, biology and especially in mathematics, Astronomy is present. We have mentioned here some curiosities related to Astronomy in these fields of knowledge: the days of the week, an essay which we worked about the eclipse of the Sun ('Let's see the Sun hiding'), another one about eclipses (worked at Francisco Ivo State School in Natal). "Meeting Mars" (worked in the biggest approximation of Mars with Earth in the last 63.000 years on August 27, 2004). Anyway, about it, it always happens in August, e-mails got repeated with exaggerated advertisements that Mars will be very close to Earth, being visible sized similarly as a full Moon. In this way, we can see in every August 27 "two full Moons" in the sky. Unfortunately, a lot of people believe in what appears on the internet without questioning and not even searching to know in what moon phase we are. We have also debated themes such as: the constellations, the first day of April and the firmament as a national symbol (in this article we dealt with the representation of every star in the national flag).

4.1. The firmament as a national symbol

The sky always exerted some fascination and source of inspiration to mankind. The progress of the cities made us dive in a world of artificial lights and forget the enchants of a star night. However, it was the systematic observation of the firmament that made possible a so big reach in the development of technology of vision, photography, telecommunications etc. All peoples, anyway, have knowledge about it and perhaps they express it in their national symbols like the flags.

The Brazilian flag, for example, one of the most beautiful and suggestive of the world is also the only one to possess a celestial

sphere. Adopted on November 19th , 1889, it has a star depicting every State of the federation. This depicting corresponds to the star which was on the zenith of the capital of every State in the moment of its homologation, twelve sidereal hours in Rio de Janeiro (the country's capital at that time).

Some exceptions are made, such as: the equator is depicted by the band *Ordem e Progresso.* The star which appear above that line represents the state of Pará, showing that our territory has areas above and below the terrestrial equator. Thus, the capital of the nation, Brasília, is represented by the star σ oct (Sigma Octantis), which is the current South star of the celestial sphere where all the other stars orbit. So, it all means that as the capital is the center of all decisions, all States have to go round the center star.

In this way, some constellations are more easily identifiable than others, for example, the Southern Cross, the Orion and Scorpius constellations.

All Northern states, but Bahia, are part of the Scorpius constellation, such a magnificent zodiac constellation easily recognizable in the sky, whose brightest star is Antares which depicts the state of Piauí. Finally, the state of Rio Grande do Norte is represented by the star λ Sco (Lambda Scorpii) whose name is Shaula. It is a star of magnitude 2.

Concerning magnitude, its value does not express any prejudice at all, it is just the location of its position in the sky at the time of the flag homologation. So, it is already worth mentioning that Brasília is represented by the star σ oct (Sigma Octantis), has magnitude 5 and the brightest star in the sky is Sirius which symbolizes the state of Mato Grosso.

As a result, the Scorpius constellation is in a place in the sky full of celestial objects that can be observed with small tools.

Figura 54. The Brazilian flag, being highlighted the Scorpius constellation. Extracted in the astronomy of Zenite.

α Sco	Antares	1	Piauí
β Sco	Graffias	3	Maranhão
ε Sco	Wei	2	Ceará
θ Sco	Sargas	2	Alagoas
ύ Sco	-	3	Sergipe
X Sco	Girtab	3	Paraíba
λ Sco	Shaula	2	Rio Grande do Norte
μ Sco	-	3	Pernambuco

4.2. The weekdays and Astronomy

One of the most important events of Astronomy is by taking us to the origin of big list of customs and names. Thus, it is the study of the names of weekdays. So, there is a very nice star which regularly gives us resources to count down the time: The Moon. Seven days correspond to every phase of the Moon and to this period was called week (*septimana*: seven mornings).

Then, for every day of the week, a star should be related to something from Earth like a God. In this way, the first day was devoted to the Sun, the second to the Moon, the third one to Mars (God war), the fourth to Mercury for the Greek: Hermes – a messenger dust from the Gods; To Romans (a God devoted to commerce), the

fifth was devoted to Jupiter (the God of lightning and thunder, the master of the skies according to the Greeks: the Lord of growing); the sixth was devoted to Venus (the Goddess of love and beauty) and the seventh was devoted to Saturn (the God of time). Thus, people honored the Sun, the Moon and the five visible planets to the naked eye from our planet: Mercury, Venus, Mars, Jupiter and Saturn.

In the Portuguese language, the custom of giving the name of "*feira*", save Saturday and Sunday comes from the religious ceremonies of the passion, death and resurrection of Jesus Christ. So, in the first centuries of Christianism, every holy week was devoted to prayers and meditations, that is the reason of the use of the word "*féria*" (*feriae* from Latin, meaning holiday) doing only indispensable work.

The table 4 below shows the symbology and names in Portuguese and the corresponding names in Spanish, French, English, Italian and German.

Symbology	Portuguese	Spanish	French	English	Italian	German
Day of the Sun	Domingo	Domingo	Dimanche	Sunday	Domenica	Sonntag
Day of the Moon	Segunda-feira	Lunes	Lundi	Monday	Lunedi	Montag
Day of Mars	Terça-feira	Martes	Mardi	Tuesday	Martedi	Dienstag
Day of Mercury	Quarta-feira	Miércoles	Mercredi	Wednesday	Mercoledi	Mittwoch
Day of Jupiter	Quinta-feira	Jueves	Jeudi	Thursday	Giovedi	Donnerstag
Day of Venus	Sexta-feira	Viernes	Vendredi	Friday	Venerdi	Freitag
Day of Saturn	Sábado	Sábado	Samedi	Saturday	Sabato	Samstag

4.3. The constellations

Astronomy is one of the oldest sciences, or one might say it is the oldest, perhaps for it is so accessible and it is at our eyes' reach. Anyone can explore it by only looking at. And when we do, we face ourselves with stars, constellations, agglomerate rocks, planets… So, questions arise, for instance, what are constellations?

Constellations are grouping of stars, which ancient astronomers wondered to form pictures of people, animals, and objects. They came up in the Ancient Time and had many uses. In this way, the International Astronomical Union accepts nowadays the existence of 88 constellations, among them, the constellation of Scorpio, which represents a big part of the Brazilian States in its stars. The Rio Grande do Norte State is represented by the star λ sco (*Lambda Scorpii*, also named Shaula). Thus, the first classic constellations were catalogued by the Greek astronomer Ptolomeu in 137 A.D. and the others were discovered with the maritime expansion by the Great Navigations, and with the advent of the big instruments of observation developed by technology. As a matter of fact, the constellations of the zodiac represent mostly animal shapes and represent the path described by the Sun along one year.

Moreover, the constellations are celestial objects that give us lots of fascination, for they are in our lives 24 hours a day, though we only watch at them at night, because they are rich in legends and myths in the Ancient Time. So, in the navigations of the Ancient Times, they had important meaning as a form of night orientation.

4.4. April First – "Fool's Day". Why?

It does not look, though, but it is an astronomical question which refers to the calendar and the date of the beginning of the year. The thing is that in several cultures and civilizations the year had and still

has different dates for its beginning, however, today all peoples take the calendar based on Christianism.

In this way, the reason that April first is considered the day of playing jokes and hoaxes refers to the French calendar. So, on one hand, for the French, the year began in April. Then, it was a tradition in the first day of the New Year the exchange of presents among friends and congratulations vows during its passage. On the other hand, for the Romans, the year started in March first.

In the year 708 of the foundation of Rome (45 A.D.) Julius Cesar did the reform of the calendar – Julius' reform, determining that the annual calendar had its beginning in January First coinciding with the equinox of spring in the North hemisphere. This reform had a slow acceptance among the other nations. So, among the resistant ones were the ecclesiast leaders which were reluctant to accept the beginning of a year in the month of January which honors Janus, a pagan divinity. The pope Gregorius XIII reformed the Julian calendar, but kept the beginning of a year in January.

The famous plays of April First began around the fifteenth century. They were made by fake gifts and/or playing tricks to simulate the celebration of the old New Year's Day. So, a series of facts was associated to "Fishes of April", referring to the exit of the Sun of the Pisces astrological sign. Thus, the news noticed fake and sensationalist events aiming to draw the credulous' attention. Soon, it got spread around the world and even today people celebrate the first day of April as the Fool's Day.

5. SONGS, POETRY AND ASTRONOMY

The charming of the sky was and is part of the human expressions and feelings in all times: in arts, music, poetry and other forms of care. We highlight here the lyrics of some songs and poetries which are part of the Brazilian repertoire. After the lyrics, we explore the meaning of themes related to Astronomy in a questionnaire. For example, we mention the samba-plot of the Unidos da Tijuca School in 2009 by Júlio Alves and Totonho, entitled "***Tijuca 2009 uma odisseia sobre o espaço***" beyond the stars which honors the International year of Astronomy. The boldfaced words are those associated to Astronomy. After some songs or poetries, we made a questionnaire which is debated in groups.

5.1. "*Tijuca 2009 uma odisseia sobre o espaço*"

Songwriters: Júlio Alves and Totonho
Singer: Bruno Ribas

A **nave** vai **pousar**
E conquistar seu coração (bis)
O **dia** vai chegar
Quando **brilhar** nossa **constelação**

Dourado é o **sol** a clarear
No **azul** do **céu**, estende o véu, isso é tijuca
Chegou, na **cauda do cometa**, o pavão
E a minha **estrela** foi buscar na **imensidão**
Cruzou o céu no limiar do **infinito**
O meu borel visto de cima é mais bonito
Eu vou alçar ao **espaço**
Cavaleiro alado a desvendar
Além das **estrelas** o monte de zeus
Horizonte de meu deus, oxalá
Vai tijuca, me faz delirar
A essência vem de lá
Da **ciência** a navegação
Luar que embala meus sonhos
Luar de qualquer estação

Eu vi **brilhar**, em seu olhar, a devoção
A lenda do guerreiro e o dragão
O despertar da fantasia
Vi também, a criança em seu carrossel
De heróis das **estrelas**, um céu
De mistérios e magia
Na tela, tantas **jornadas** pelos **astros**
Quem dera poder viver em pleno **espaço**
Vejo em minha **lente** a imagem **sideral**
Viagem do meu carnaval

A **nave** vai **pousar**
E conquistar seu coração(bis)
O **dia** vai chegar
Quando **brilhar** nossa constelação

Questions:

1. What is the sky?
2. What makes the sky have a blue color?

3. What is a comet? What provokes the appearance of its tail?
4. What is a star?
5. What is hugeness for you? Is it infinite?
6. What is the sidereal space?
7. What is the horizon?
8. What is moonlight?
9. What causes the brightness of the moon and stars?
10. What are celestial stars?
11. In your opinion, what does the author want to say by stating that: "*a nave vai pousar*"?
12. What causes the appearing of days and nights?

5.2. Lua Vadia

Songwriter: Marcos Farias
Singer: Elba Ramalho

Lua da minha janela
Singela **lua** vadia
Lua nova, lua cheia
Poesia que **clareia**
Minha rua, meu quintal
Lua branca cristalina
Brejeira lua menina
Matutina, sensual

Lamparina do **universo**
Do meu verso solitário
Minha reza, meu rosário
Meu diário, meu cordel
Meu romance clandestino
Meu destino carrossel
Minha doce namorada
Minha amada lua de mel

Quando à **noite** em minha cama
Tua luz fogosa e bela

Vem brechar minha janela
Sobejar-me de emoção
Corpo inteiro, toda nua
És a lua do meu cio
Do meu coração febril
No vazio da solidão

Questions:

1. What is the Moon?

2. What is the New Moon?
3. What is the Full Moon?
4. Is it possible to see the New Moon?
5. What causes the changes in the Moon phases?
6. Is it possible to see the Full Moon during all year nights?
7. When the moon is not neither New nor Full, how does it present itself?
8. Draw a picture representing the Moon in the different shapes as you see them.
9. In your opinion, what does the author mean with "*lua matutina*"?
10. In your opinion, what does the author mean when he states the moon is "*lamparina no universo*"?
11. What is the universe for you? Draw it in a sheet of paper.
12. What is the light for you?
13. When you see the Moon, is it because the light is produced in the moon itself?
14. What is the night for you?
15. Is it only possible to see the Moon during the night? Explain.

5.3. Lindo balão azul

Songwriter: Guilherme Arantes

Eu vivo sempre
No **mundo da lua**
Por que sou um cientista
O meu papo **futurista**
É lunático

Eu vivo sempre
No **mundo da lua**
Tenho alma de artista
Sou um gênio sonhador
E romântico

Eu vivo sempre
No **mundo da lua**
Porque sou aventureiro
Desde o meu primeiro passo
Pro **infinito**

Eu vivo sempre
No **mundo da lua**
Porque sou inteligente
Se você quer vir com a gente
Venha que será um barato

Pegar carona
Nessa **cauda de cometa**
Ver a **via láctea**
Estrada tão bonita
Brincar de esconde-esconde
Numa **nebulosa**
Voltar pra casa
Nosso **lindo balão azul**

Nosso **lindo balão azul**
Oh! Oh! Oh! Oh!

Nosso lindo balão azul
Uh! Uh! Uh! Uh!

Questions:

1. What means: *vive no "mundo da lua*"?
2. In your opinion, every intelligent person "*vive no mundo da lua*"?
3. What is it by being futurist?
4. What is the infinite?
5. What is a comet? Draw one in a sheet of paper.
6. What do you think a comet is made of?

7. Have you ever heard of a comet?
8. What is the tail of a comet?
9. What is the Milky Way for you? Draw a picture to represent it.
10. In your opinion, what does the author mean by stating that the Milky Way is: "*uma Estrada tão bonita*"?
11. What is the nebula for you?
12. Is it easy to hide in a nebula?
13. Who is the "*lindo balão azul*"? Who does the author refer to?
14. In your opinion, why the songwriter says his house is "*um lindo balão azul*"?

5.4. Planeta Água

Written by Guilherme Arantes

Água que nasce na fonte
serena do mundo
E que abre um profundo grotão
Água que faz inocente riacho
E deságua na corrente do ribeirão

Águas escuras dos rios
Que levam a fertilidade ao sertão
Águas que banham aldeias
E matam a sede da população

Águas que caem das pedras
No véu das casca-
tas, ronco de trovão
E depois dormem tranquilas
No leito dos lagos
No leito dos lagos

Água dos igarapés
Onde Iara, a mãe d'água
É misteriosa canção
Água que o **sol** evapora
Pro céu vai embora
Virar nuvens de algodão

Gotas de água da chuva
Alegre **arco-íris** sobre a plantação
Gotas de água da chuva
Tão tristes, são lágri-
mas na inundação

Águas que movem moinhos
São as mesmas águas
que encharcam o chão
E sempre voltam humildes
Pro fundo da **terra**
Pro fundo da terra

Terra! Planeta Água
Terra! Planeta Água
Terra! Planeta Água

Água que nasce na fonte
serena do **mundo**
E que abre um profundo grotão
Água que faz inocente riacho
E deságua na corrente do ribeirão

Águas escuras dos rios
Que levam a fertilidade ao sertão
Águas que banham aldeias
E matam a sede da população

Águas que movem moinhos
São as mesmas águas
que encharcam o chão
E sempre voltam humildes
Pro fundo da **terra**
Pro fundo da **terra**

Terra! Planeta Água
Terra! Planeta Água
Terra! Planeta Água…(2x)

Questions

1. What is world for you?
2. In your opinion, what is the world in the words of the author?
3. What is the Sun?
4. What is the sky for you? Draw one in a sheet of paper.
5. In your opinion, thunder is a phenomenon of the Earth or sky?
6. How many suns are there in the sky?
7. What is the planet for you?
8. How many planets have you heard of? Which ones?
9. How many planets are there in the solar system?
10. In your opinion, how many planets have been visited by space ships?
11. In your opinion, what does the author mean by stating that Earth is "*planeta água*"?
12. In your opinion, is it possible to have water in other planets? And beyond our galaxy, in other places of the universe? Why?

5.5. As pastorinhas

Written by Noel Rosa and João de Barro

A **estrela d'alva** no céu desponta
E a **lua** anda tonta com tamanho esplendor
E as pastorinhas pra consolo da **lua**
Vão cantando na rua lindos versos de amor

A estrela d'alva no **céu desponta**
E a **lua** anda tonta com tamanho esplendor
E as pastorinhas pra consolo da lua
Vão cantando na rua lindos versos de amor

Linda pastora morena da cor de madalena
Tu não tens pena de mim
Que vivo tonto com o teu olhar
Linda criança tu não me sais da lembrança
Meu coração não se cansa
De sempre sempre te amar

Questions

1. What does the term "*Estrela d' alva*"? Does it really refer to a star?
2. What is the sky? Make a picture to represent one.
3. What is a planet?
4. How is it possible to see a planet from Earth?
5. What is the difference between planet and star?
6. What is color?
7. What do the colors of the star represent?
8. In your opinion, what does the author mean by saying that "*a estrela d'alva no céu desponta"?*

9. What is the Moon?
10. Is it possible to go to the Moon by plane?
11. Is it possible to live in the Moon?
12. How many people have already stepped in the Moon's soil? And in other planets?
13. The moon is a natural satellite of Earth, are there satellites in other planets?
14. How is it possible to observe other moons in other planets?
15. How many moons do you think are there in the solar system?

5.6. Sonho Cosmogônico

Songwriter: Nadir D'Onófrio

Saio vertiginosamente
Passando do **nadir** ao **zênite**
Rompendo o **espaço infinito**
Ofusca-me o brilho das **estrelas**!
Iluminando o **firmament**…

A paz que agora sinto
Gostaria de compartilhar com você!
São bilhões de **corpos celestiais**…
Na mais perfeita harmonia
Parecem que estão a bailar!

Suave música ecoando…
Que estranha solução me dá…
Leve como uma pluma!
Pela **Via-láctea**
Sinto-me flutuar…

Nesse tapete **estrelar**
Vou regredir no tempo voltar!
Ver, sentir, ouvir, o **universo** eclodir
Como fogos de artífício!
Em miríades de **cor**…expandir

Questions

1. What is a *nadir*?
2. What is a *zênite*?
3. What is the space?
4. In your opinion, the space is finite or infinite?

5. What causes the brightness of the stars?
6. What is the firmament?
7. What are celestial bodies?
8. What is the Milky-Way? Why does it have this name?
9. What characterizes the color of the stars?
10. In your opinion, is it possible to estimate how many stars are there in the universe?

6. THE OBSERVATIONAL WORK

Due to constraints of our material, we worried to observing what could be visualized in the sky in the naked eye and with small instruments. Thus, we tried to make observations in the Moon in its first quarter phase. To the lay people, they think that the best period of observation is the Full Moon phase for it shines more in the sky. It can be true if we observe it in the naked eye. However, concerning other observation instruments, it is worth highlighting that in the Full Moon, a big amount of light reaches the equipment and it damages our eyes and the observation of other celestial bodies.

During the observation of planets and satellites, we highlight that to observe them

It is not only necessary to point the equipment to where one desires to see. Every planet has their own dates and times to be visible in the sky, according to its geographical location. The planets which could be seen in the naked eye were already known since the Ancient time because they distinguished from the stars by the apparent movement inside the supposed transparent crystal sphere in which people believed the stars were fixed. So, the known planets were Mercury, Venus, Mars, Jupiter and Saturn.

Thus, the order of distance is not the same of the best observation: the easily visible and identifiable are: Venus, Jupiter, Saturn, Mars and Mercury. Venus, although it only uses to appear in the sky of our region (Northeast of Brazil) a little bit after the sunset and little before the sunrise for being the most shining star of the nights after the Moon. Jupiter can shine all night long and its shine is a bit less than Venus one, being the third most shining of the nights. Thus, with our instruments, we had seen the four satellites discovered by Galileo. Right now, we point out that having a satellite is not a privilege or our planet for even the little planet Pluto has more bodies to orbit it than us. Then comes

Saturn, in the naked eye the majestic rings cannot be identified (as a matter of fact, the rings are the charming of our journeys, because many people get in line to observe them through the telescope.

Differently from the stars that produce their own light, the planets and their satellites are only visible due to reflecting sunlight. They do not have their own light. In this way, they are called illuminated objects, while the stars are called luminous objects. However, because of the big distance to the Sun, the reflected light by them can arrive weakly in the Earth and then, we cannot see them in the naked eye. Thus, we cannot see Uranus, Neptune and Pluto (now classified in a new class of planets: the dwarf planets) with the naked eye.

Besides the planets visible with the naked eye, we can see a big number of stars. The human imagination makes us relate some settings in the nocturnal sky with the anxieties and objects here from Earth. So, people created dwellings of mythological gods, put our devices and instruments and associated celestial events with terrestrial happenings.

Moreover, imagination made mankind see mythological and legendary figures in the sky. There, the ancient peoples make the dwelling of Gods. It was believed that our Earth was fixed in space where stars where fixed stars in a sphere pictured named celestial sphere which moved around our planet, considered the center of the world. To observational effects, it is convenient to think of the stars really as fixed dots in the interior of a huge sphere – the celestial one. So, in its center, there is Earth which spins like a pawn from West to East, completing a rotation every day. What can be seen in the sky depends on the geographical position in Earth, in other words, latitude and longitude. Historically, the Portuguese and Spanish navigators did not know some constellations. These are groups of stars visible only in the South hemisphere of the Earth, for instance, the Southern Cross. In our position, next to the Equator, a little bit below the latter we can see constellations of the North and South hemisphere. We can mention

Orion, Taurus, Southern Cross and Scorpio and the two closest stars in our planetary system: Alpha and Beta Centauri as easily visible. Other stars are highlighted by their brightness, such as Sirius, the brightest star in the nocturnal sky.

We point a LASER towards that we can identify and its location gets easier. Also, we highlight that the stars of a constellation are not equally far from us, it is just a question of visualization.

So, when we observe the Scorpio constellation and others which have some relation with the Brazilian flag, we emphasize the State it represents and the symbolism it had in the creation of the Brazilian flag.

It is worth mentioning that not always the meteorological conditions allow nocturnal observations.

The two figures below are pictures kindly authorized by José Carlos Diniz[13]: the first of them shows the constellation of Orion and the second one, the Southern Cross.

Figura 55. The constellation of Orion, emphasizing “The Three Marys”. Photo taken by José Carlos Diniz.

13 He is a cardiologist and amateur astronomer who takes the best astronomical pictures in Brazil and one of the best in the world in astrophotography.

Figura 56. The Southern Cross. The picture was taken by José Carlos Diniz. The flat line in the picture was made by the passage of an artificial satellite.

7. ASTRONOMICAL EVENTS

Among the astronomical events it is worth mentioning some which have received a great emphasis in the local and national press, such as solar and lunar eclipses, meteor rains, Venus and Mercury traffic, stars and planets omission by the Moon, solstices and equinox and appearance of comets.

It is already a tradition in some of our schools, teachers working with the Flag's day in November 19th . Thus, we have emphasized the symbolism that the stars represent; in the same time, we search for some of these stars which represent States of the Brazilian federation.

7.1. Eclipses

it is called eclipse the partial or total darkening of a celestial body for the intervention of another star. In the lunar eclipses our satellite is no longer visible when getting into the Earth shadow cone, due to the associated movements of the Moon around Earth and of the Earth around the Sun. Thus, in the solar eclipse, which is only possible to happen in the New Moon phase, our satellite is between the Sun and Earth. It is partial only when part of the Sun is visible to a specific area of the Earth. In the lunar eclipse, which is only possible in the Full Moon phase, the Moon gets in the opposite side between the Earth and Sun.

In the history of mankind, eclipses have stimulated the mythic and superstitious side of the human mind. Their fear contributed so that we had a great number of valuable registrations of celestial phenomena, especially the eclipses observed by the Chinese, Egyptians and Mayans in the Pre-Columbiana America. However, this feature connected with fear has helped us a lot in the development of Astronomy, once it made possible a search for studies aiming to make occurrence previews and a best knowledge of the celestial phenomena

as a whole. The science as a human creation cannot make prejudicial judgments about popular culture. Particularly, the Astronomy searches for explanations based on scientific facts coherent with the observations so that we could predict in what conditions, dates and places the astronomical events will happen.

Figura 57. The eclipsed Moon. The red coloration is due to the dispersion of the solar rays in the high terrestrial atmosphere. Photo taken by José Carlos Diniz in Rio de Janeiro on March 24th , 1997.

Figura 58. The eclipse Sun showing the diamond ring. Photo taken by José Carlos Diniz on February 26th , 1997.

In our work, we invited students to represent the involved characters.

7.1.1. "Let's see the Sun hide"

— Is the Sun going to hide? What is that? Where and when is it going to be?

— Calm down! One question at a time. First! An eclipse is going to occur, a solar one. The king star is no longer be visible for a short period of time. The Moon will be in front of it.

— And is there an eclipse which is not solar?

— Yes, there are lunar eclipses, too and other kinds of eclipses which are not relevant to talk now.

— But…, where is the Sun eclipse going to be?

— It is going to be on March 29th , 2006. It will be the first total eclipse of the Sun which is visible in Brazil in the third millennium. It begins to be visible here in Brazil, more precisely in Rio Grande do Norte.

— Is it going to be seen only here in Rio Grande do Norte?

— No, but in its totality, it is going to be visible only here in Rio Grande do Norte. It is going to begin here, but the shadow of the Moon will continue omitting the Sun through the Atlantic Ocean and will extend to the North of Africa, following the Central Asia and finishing in the sunset in the West Mongolia.

— Is it going to be possible to see it in all Rio Grande do Norte cities?

— No, the ANRA[14], the *Associação Norte-Riograndense de Astronomia* is collecting all information about that and it has a map at the disposal of the interested people in the matter.

— What is this thing of totality? By the way, we can see only a piece of the Sun?

14 ANRA is the Norte Riograndense society of Astronomy.

— That's right! There are places and occasions in which the Sun does not get totally uncovered by the Moon. In this case, the eclipse is called partial.

— Is it necessary to fear the eclipses?

— No, the eclipses are natural phenomena due to the movement of the Moon around the Earth, and the Earth around the Sun. For a long time, humanity without knowing how and why explain the eclipses, they got afraid every time it happened. However, it helped somehow in the search for explanation and also to make very important previews to the knowledge of the universe.

— Wow! I will talk to my friends and neighbors so that we get informed of some cities and look at the eclipse!

— Easy! It is not like that, though. The sunlight is very strong, the heat is also prejudicial to the skin and besides, the Sun emits invisible solar rays highly damaging to the eyes. Look at the sky? Only with protection. Special glasses, made by welder's glass number 12 can be used. It is also possible to see the eclipse through the projection of its shadow in a screen.

— So, I cannot use binoculars or a telescope to see the eclipse?

— No, the best instrument of optical observation is the eye, that is why we must protect it. Other instruments are also important to our knowledge of the universe. However, they get more light than the eye, then the light they receive from the Sun will be stronger. What makes worse the effects on vision which are irreversible.

— Who promotes this event?

— Well, this event is promoted by the forces of nature due to associated movements among Earth, Moon and Sun. The Moon around the Earth and the Earth around the Sun.

— Is there an organization supporting this event?

— It cannot be said that a celestial event has a supporter. Several worldwide organizations are announcing it. In our case, the ANRA is going to be observing and informing the population about this wonderful event which takes lots

of time to occur in the same place in the planet, did you know that? The last one was seen in 1940. In that time, many people got afraid. Today, we are going to have fun, though, and learn more about the sky.

— Oh, I won't miss it and will invite all my friends. It will be pretty cool!

— OK! The sky exists to be admired and observed by everybody.

7.1.2. "The eclipse of the Sun"

In the Teacher Francisco Ivo State school, there was a great expectation around an eclipse of the Sun which would occur in the following day…

From the Headmaster to the vice-headmaster

The ANRA president spoke that tomorrow there will be a total eclipse of the Sun. To look at it, it is necessary to protect our eyes. We should not look at the sky with the naked eye. The eclipse causes a swift reduction of temperature. It does not happen every day… Ask everybody to group the students in the patio at 7 o'clock, all in their school uniforms… Everybody will be able to observe the phenomenon which I will give some explanations. If it rains, nothing could be seen and the students will be in their classrooms waiting to the attendance register…

From the vice-headmaster to the pedagogic advisor

As an order of the ANRA president and the headmaster there will be a solar eclipse tomorrow and the temperature will decrease… You cannot look at the sun with the naked eye. So, we should keep our eyes open and protected. The headmaster will give explanations and make observations at 7 o' clock, and that does not happen every day. If it

rains, there will not be the attedance register in the patio. The eclipse will be in the classrooms…

From the pedagogic advisor to the teachers:

Tomorrow at 7, you will come to our school, along with the ANRA members, a total solar eclipse. You should come with the complete uniform and masks to cover the eyes. You should not be naked so that you will feel cold. If it does not rain, what does not happen every day, the headmaster will give explanations, which will be too bad…

From the teachers to the students:

Attention, everybody! Tomorrow at 7, the headmaster will make a solar eclipse with the ANRA members. So, you should come with the complete uniform and stay with your eyes closed for your own safety and the headmaster will give explanations. We will not accept nobody who comes badly dressed or naked. Who does not look with the appropriate protection can get your eyes damaged, and it can be very bad. You should pay a lot of attention to the classroom, what does not happen every day. If it rains, there will not be the class register…

Among the students:

The teachers said that tomorrow the ANRA will come with the Sun, with the complete uniform to our school to make an eclipse to the headmaster and give her some explanations. The Sun does not want to see nobody naked or our heads will burn. You know how it sounds: the teachers make up this thing of eclipse for not teaching us, you know, and when it comes to the crunch, everything darkens and we cannot see anything. If it rains, the party will be cool, because nobody will see any eclipse

at all. It starts at 7, and I do not give a damn about it. I will take a bath naked in the rain, for if it gets dark, nobody will see me.

Some questions related to the text "The eclipse of the Sun"

1. How many times is the Moon smaller than the Earth?
2. What is the covered area by the shadow of a solar eclipse?
3. At what speed the shadow of the Moon moves over the Earth during a solar eclipse?
4. How long does the total solar eclipse last in the maximum?
5. In what conditions, does the Moon stay totally in front of the Sun and the eclipse does not occur?
6. What is the minimum number of eclipses a year and what is its specificity?
7. Do you remember the last time a total eclipse of the Sun happened in your city? And your grandparents, do you remember if they talked to you about that someday?
8. What is the last total eclipse of the Sun that occurred in the Brazilian northeast and from what states was it visible?
9. What are the last eclipses visualized in Rio Grande do Norte?
10. What is the last total eclipse of the Sun seen in Brazil? Where was it visible?
11. When and where was the last solar eclipse seen?
12. What are the next total solar eclipses to be seen in Brazil and in what states will they appear?

Table 5. Solar total eclipses observed and registered in Brazil from the seventeenth to the twenty-first century.

date	visibility	Duration(minutes)	Name
11/16/1640	Northast (RN, PB, PE)	4,5	Geor Marcgarf eclipse
02/20/1784	Central Brazil	2,7	Sances Dorta eclipse
02/09/1785	South	4,8	Sanches Dorta eclipse
09/07/1858	South	1,7	Parnaguá eclipse
04/25/1865	South	5,3	Camburiú eclipse
04/16/1893	North	4,8	Pirapora eclipse
10/10/1912	Central Brazil	1,8	Passa Quatro eclipse
05/29/1919	Northeast(PI, CE)	6,9	Sobrl eclipse[15]
10/01/1940	Northease(RN, PB, PE)	5,7	Pernambuco eclipse
01/25/1944	South	4,1	The Second War eclipse[16]
05/20/1947	Central Brazil (MT, MG)	5,2	Bocaiúva and Araxá eclipse
11/12/1966	South	1,9	Bajé eclipse

15 This eclipse was seen in Peru, Atlantic Ocean in Brazil, Central Africa and Mozambique. A detailed report was published by Henrique Morize (1860-1930), under the title "Resultados brasileiros obtidos pela comissão do eclipse de 29 de maio de 1919"in Revista de Siencias, Rio de Janeiro, 4(3) 65-81, May-June, 1920. During this eclipse, two missions from Greenwich observatory were sent, one for Sobral and the other to Prince Island, West coast of Africa. To Sobral came the astronomers A.C. D Crommelin and C.R. Davidson. In Sobral eclipse, it was checked out the "Einsten effect". The astronomer Arthur Eddington took notice about the eclipse occurred in May 29th when the Sun would be close to region very rich in shining stars: the Hyades agglomerate in the Taurus constellation. Thus, as predicted by the general theory of relativity by Einstein, it would be possible to observe the deflection of the solar rays when passing close to the Sun. The Brazilian commission gave little importance to the validation of the theory predicted by Einstein, however, the English revealed details which were publicized in science academies worldwide.

16 Because of the War, no foreign mission came to Brazil.

07/11/1991	North (AM, PA)	7,1	Tefé/Manicoré eclipse
06/30/1992	South	5,4	Atlântico Sul eclipse[17]
11/03/1994	South	4,6	RS/SC eclipse
04/29/1995	Northeast (CE)	6,0	Annular eclipse of Fortaleza
03/29/2006	Northeast (RN)	1,5	Rio Grande do Norte eclipse[18]

7.2. Solstice

What is a solstice? In astronomy, solstice is the moment in which the Sun during its apparent movement in the celestial sphere, reaches its bigger separation in latitude from the equator. The solstices occur twice a year: in June 21 and December 21.

A curious thing is when there is a solstice of winter in the South hemisphere of the Earth, a solstice of summer happens in the North hemisphere. Why does it happen? Our days do not have the same duration of nights. In other words, during the period of 24 hours, there are not 12 hours with the Sun above the horizon and 12 hours without it. Thus, considering the day as the time in which the Sun is visible above the horizon and, night when it is underneath. In two moments, these periods are the same, they are called equinoxes. In the winter solstice, to observers placed in the South hemisphere, the day will be the shortest, while for the observers of the North one, the day will be the longest. For us, who are close to the equator, this difference practically is not noticed. As more separated of the equator, more drawn up will be the solstices. Why does it occur? Due to the elliptical orbit

17 It was observed onboard a Boeing 737-300 from Vasp by a team of 30 astronomers.

18 It was until now the first and last solar eclipse visible in Brazil in the twenty-first century. The next one is predicted to occur in 2043.

of the Earth, the dates the solstices occur do not divide the year in an equal number of days and nights, in other words, there are not 12 hours of Sun and 12 hours without seeing it.

The Tropic of Cancer and Capricorn are defined because of the solstices. In the summer solstices, in the South Hemisphere, the solar rays happen perpendicularly to Earth in the line of the Tropic of Capricorn. In the winter Solstice, the same thing occurs in the Tropic of Cancer.

A curious thing on the solstices: it is known that in several ancestral cultures around the globe, the winter solstice was feasted with celebrations which originated many customs related today with Christmas. The winter solstice, the smallest in the year, when the day starts to grow symbolized the beginning of victory upon darkness.

7.3. Equinox

In Astronomy, equinox is defined as one of the two moments in which the Sun in its apparent orbit crosses the plan of the equator (the equator line designed in the celestial sphere). More precisely, it the ecliptic point crossing the celestial equator.

The word comes from Latin and means “same nights”. The equinoxes happen in March and September, the months when the day has the same duration of night. Measuring the duration of day, it is considered that the sunset is the moment that half of the solar body is above (or half below) the horizon, and the sunset, the moment that the solar body is half below (or half above) the horizon. According to this definition, the day during the equinox has 12 hours of duration.

In the North hemisphere, the spring equinox occurs in March 20th , and the Fall one occurs in September 23rd . These dates characterize the beginning of the respective seasons of the year in this hemisphere.

In the South hemisphere, the opposite occurs, the spring equinox happens in September 23rd and the Fall one in March 20th . These

dates characterize equally the beginning of the respective seasons in the hemisphere mentioned above.

Due to the elliptic orbit of the Earth, the dates where the equinoxes occur do not divide the year in a same number of days. It happens because when the Earth is nearest the Sun (perihelion), it travels quicker than when it is farther (aphelion).[19]

7.4. Transit

The term transit in Astronomy has two meanings: it can refer to the passage of a celestial body across the observer's meridian, or the passage of an interior planet in front of the solar disc. We refer to the second meaning when talking about the phenomenon which can be observed on November 8th , 2008.

Anyway, a transit is a type of eclipse (partial) of the Sun by an interior planet (Mercury or Venus). The transits of Mercury are phenomena relatively frequent: in average numbers, about 13 transits occur in every century. The first transit of Mercury observed and registered was the one in November 1631 (375 years ago), seen by Pierre Gassendi in Paris.

The transit observation implies in the observation of the Sun. In this way, every single care is necessary and the previous warning is essential and must be rigorously obeyed. The utilization of filters must be done, too, with a lot of care, avoiding the use of materials and procedures whose security we are not sure. There is no need to avoid the observation and watch the phenomenon by television or internet. So, the observation of astronomical phenomena with the suitable care, should be done "live and in color"! Here are some tips so that you can observe the transit in safety:

19 Aphelion is the position in which the star is farthest from the Sun.

To the observation of the transit of Mercury and solar disc, without the use of optical equipment, it is necessary the use of a filter. A very efficient one, of low cost and easy acquisition is the glass to welder's mask number 12. Putting it before the eyes, it is possible to weaken a lot the solar brightness and filter the radiations which are damaging to the eyes, avoiding serious risks to vision. The observation must be done in brief periods and followed by periods of "rest". Thus, a good procedure is to observe the Sun through the glass for about 5 to 10 seconds and after that, "rest" for about 10 to 20 seconds. Because of the small ratio between the apparent diameters of Mercury and the Sun, in the direct observation with the use of this filter, it can be a little hard to observe the planet.

7.5. Meteor showers

The meteors, also popularly known as shooting stars, are phenomena associated with the entrance in the terrestrial atmosphere of small solid particles coming from space. When diving through the air in high speed, these particles leave behind shining luminous traces due to friction and the ionization generated in the higher layers of the atmosphere.

This beautiful phenomenon can be appreciated with naked eyes and under good visibility conditions, it is possible to see some meteors per hour during an observation night. However, in some times of the year, the Earth in its orbit around the Sun passes through regions with a big concentration of tiny particles of dust left behind by comets which visited the solar system. Therefore, occur the so-called meteor showers.

Every rain has a radiant.[20] It names the shower according to the constellation where it locates; for instance, the chart below represents the main showers. The maximum corresponds to the date in which the

20 Position in the sky where apparently the meteorites originate.

meteors reach with a higher frequency the terrestrial atmosphere and the hour rate correspond to the average of meteors that are observed per hour.

The observation of the meteor showers requires good atmospheric conditions and a place far from the luminous pollution of the big cities. The table 6 below shows the main meteor showers which happen in our planet.

number	name	maximum	Hour rate	Constellation
01	Quadrantids	January 3	120	Boötes
02	Lyrids	April 22	15	Lyra
03	Eta Aquariids	May 5	50	Aquarius
04	Delta Aquariids	July 29	15	Aquarius
05	Perseids	August 12	80	Perseus
06	Orionids	October 21	20	Orion
07	Taurids	November 12	10	Taurus
08	Leonids	November 17	100	Leo
09	Geminids	December 14	80	Gemini

8. INSTRUMENTS OF OBSERVATION OF THE SKY

We highlight now the main instruments of observation of the sidereal space.

8.1. The most important one: the eye

When we show in the classroom binoculars, field glasses, and telescopes and question the participants of our journeys about what is more important to the observation of the sky, we get as an answer, most of the time, that the telescope is the best and most important. But the answer changes and even makes us laugh when we ask if anyone could observe anything in the telescope without the eye. However, what is the human eye? A very complex system. For what concerns our most pragmatic needs in this approach, we shorten such analysis to optical-mechanic aspects of the eye, without any goals, however, to create a fake image that it summarizes itself in such aspects.

In this way, with some reservation expressed, the human eye, considered strictly in its optical-mechanic aspect more elementary, can be seen as a sphere which measures approximately 2,5 cm of diameter, with specialized cells in the retina which allows us to distinguish colors and shapes (after the certain processing by the brain of the received signs through the optical nerve). It was adapted to work with some efficiency in the presence of strong or weak light, being close or far from it. Nowadays, it helps us to read books, as well as to observe situations and identify people. In short, the eye is a very important connection bound with the world around us, and its basic optical-mechanic characteristics works thanks to a complex ballet between muscles and nerves.

Inspired in the working of the eyes, the human being created the camera. In other words, in our eyes, the cornea works as the camera lens allowing the entrance of light in the eye and the formation of the image in the retina. Located in the inside part of the eye, the retina would be the photographic film where the image reproduces itself. The pupil works as the machine diaphragm controlling the amount of light that enters in the eye. Thus, in places with lots of light, the pupil closes itself and in dark ones, it dilates, aiming to capture an enough amount of light to form an image.

8.2. The telescope

The thing that technology and science puff up considering themselves more important than even the Creator is not a surprise for us. It is confirmed by the means of communication and even academic ones (not all) along history.

Follows some words of Descartes about the telescope:

> Having expanded our vision to beyond imagination of our ancestors, these wonderful instruments, the telescopes open an understanding view deeper and more detailed of the nature.
>
> **Renè Descartes**

From our personal view, we consider technology as a creature, in other words, it is something generated by mankind, so, not being more important than the latter. Science and technology have given us changes in our understanding of the world, as well as some improvement in the life conditions, and generated problems which deserve solution coming from science. Thus, the telescope is our vision widening. It is a window to our understanding of the universe.

What is a telescope, really?

The telescope is an instrument that widens our vision capacity. However, it does not only define it really. It is an instrument possibly invented in the Netherlands by a glasses maker named Hans Lippherey. But, its use in astronomy had its start with Galileo Galilei in Italy 400 years ago. Galileo used his instrument to observe the Moon, Venus, Mars, Jupiter, Saturn, the Sun and other stars. He made discoveries who were not in accordance with the teachings then. When exposing and publishing his discoveries, he faced some resistances in the academic and religious field. We are not going to detail here the historic facts related to Galileo's discoveries, but approach a little about the composition of the telescope.

A simple description of the telescope takes us to instruments fabricated manually by Galileo. Then, his instrument was composed of two lenses inserted within a tube. A lens is a transparent means in which at least one of the faces is curved. When light changes the propagation means, it suffers a refraction. When suffering it, the image of the objects gets changed and it can be widened or shortened. Two types of lenses were initially used in the telescope: a convergent lens and a divergent one. Next to one of them, we put our eyes while the other one is used to capture the light of the observed object. The first one is named ocular (where the eyes are put); the other one is called objective (captures the light of the object).

Then, the telescope constructed is called refractor telescope by using the refraction phenomenon to capture and widen the image. The following figures are Galileo's field glasses, and the picture of the student José Adriano, a member of our group before the field glass he made.

Figura 59. The first telescopes made by Galileo exposed in the Science Museum in Florence, Italy.

Figura 60. Adriano and his field glass.

Today we distinguished Galileo's telescope from others made and improved by Isaac Newton and Jean Cassegrain. In these ones, a concave mirror is the optical element which captures the light of the far objects, playing the role of objective light. So, the image is observed by the eye through a lens, the ocular one. Another type of telescope captures the light of the objects through a concave mirror which "plays the role of the objective lens" and the image is visualized in the eye through the ocular lens. This is the telescope developed by Jean Cassegrain, a Cassegrain telescope.

Nowadays, the optical instruments can capture much more clear images than the objects seen by Galileo and the pioneers of the telescope. The images are enlarged millions and millions times for we do not get pleased to observing the stars only from the ground. In addition, we join the Astronautics and put objects to be observed beyond the atmosphere, far away from the luminous pollution and meteorological problems. Thus, we put our eyes in orbit, captured images in cameras, camcorders, in chips in all kinds of storing ways. However, despite all enchantment that the sky provides, the optical observation is only one of the forms of capturing information on the universe. It is the lowermost part from what the sky makes available. It is already known that the visible waves are the lowermost part of the information the sky sends us, for there are electromagnetic radiations which we capture outside of the band that optics can reveal to our eyes.

Figura 61. The whole group of the Journeys observing the Sun with protective filters in the soccer field at IFRN, central campus in Natal.

The optical instruments are those which capture radio waves, X rays, gamma rays, identify planets outside of our solar system, birth of stars, stars dying, nursery of stars and planets, collisions of galaxies, quasars and black holes. Unimaginable things even to the great minds of past as Aristotle, Aristarchus, Galileo Galilei, Giordano Bruno, Nicolao Copernicus, Johannes Kepler and Isaac Newton.

Other sources of information the sky gives us about our history, our past, our chemical constitution and our search to understand the human condition and to answer a very old question: Are we alone in the Cosmos?

REFERENCES

ARAUJO SOBRINHO**,** A **RELATÓRIO DO PROJETO OBSERVACIONAL DO ECLIPSE TOTAL DO SOL DE 29 DE MARÇO DE 2006 –** UFRN - Natal-RN, 2006.

ATLAS VISUAIS. **O UNIVERSO**, Ática, São Paulo, 1997.

CANIATO, Rodolpho. **O QUE É ASTRONOMIA**, Coleção primeiros passos, v. 17. Brasiliense., 1988

DA SILVA, Cassiene S. **EXPLORANDO O UNIVERSO:** uma viagem ao infinito. A. S. Editores, Natal-RN, 2003.

COPÉRNICO. Nicolau, **COMENTARIOLUS**: Pequeno comentário de Nicolau Copérnico sobre suas próprias idéias acerca dos movimentos celestes. Tradução, introdução e notas: Roberto de Andrade Martins. Livraria de Física, 2ª edição, São Paulo, 2003.

DE MORAIS, Abraão. A **ASTRONOMIA NO BRASIL**. Universidade de São Paulo, Instituto Astronômico e Geofísico. São Paulo, 1986.

FERREIRA, Máximo & DE ALMEIDA, Guilherme**. INTRODUÇÃO À ASTRONOMIA E ÀS OBSERVAÇÕES ASTRONÔMICAS**. Plátano, edições técnicas, Lisboa Portugal, 2001.

GALILEI, Galileu. **DIÁLOGO SOBRE OS DOIS MÁXIMOS SISTEMAS DO MUNDO** o ptolomaico & copernicano. Tradução, introdução e notas de rodapé de Pablo Rubén Mariconda . Imprensa Oficial, São Paulo, 2004.

HAWKING, Stephen. **O UNIVERSO NUMA CASCA DE NOZ.** Tradução: Ivo Korytowski, revisão técnica: Augusto Daminelli. Arx, 5ª edição, são Paulo, 2001.

HAWKING, Stephen. & HAWKING, L,. **GEORGE E O SEGREDO DO UNIVERSO** Tradução de Laura Alves e Aurélio Rebello, Ediouro, Rio de Janeiro, 2007.

HEWITT. P. G. **FÍSICA CONCEITUAL**. Tradução de Trieste Freire Ricci , Maria Helena Gravina9ª edição. Bookman. Porto Alegre, 2007.

ISAACSON, W. **EINSTEIN: Sua vida, seu universo**.Tradução de Celso Nogueira, Denise Pessoa, Fernanda Ravagnani e Isa Mara Lando. Companhia das letras. São Paulo, 2007.

LEITE, Cássio V. **EINSTEIN, O REFORMULADOR DO UNIVERSO**, Coleção Imortais da Ciência, coordenação: Marcelo Gleiser. Odyseus, São Paulo, 2003.

MEDEIROS, A J. G de & ARAÚJO, F. **CONVERSANDO COM MARCGRAVE** da moderna astronomia no hemisfério sul. In Revista Latino-americana de educação em Astronomia, RELEA, p9 – 50, 2005.

MORIS, R. **UMA BREVE HISTÓRIA DO INFINITO**: dos paradoxos de Zenão ao Universo Quântico. Jorge Zahar Editor, Rio de Janeiro, 1997.

MOURÃO, Ronaldo R. de F. **DICIONÁRIO ENCICLOPÉDICO DE ASTRONOMIA E ASTRONÁUTICA,** 2ª edição. Nova Fronteira, 1995 – Rio de Janeiro

_____, Ronaldo R. de F. O **LIVRO DE OURO DO UNIVERSO**

Ediouro, 6ª edição, Rio e Janeiro, 2002.

NEWTON, Isaac. ÓPTICA. Tradução, introdução e notas de rodapé de André koch Torres Assis. Edusp, São Paulo, 2002.

OLIVEIRA FILHO, K. de S &SARAVA M. de F. O. **ASTRONOMIA E ASTROFÍSICA**. 2ª edição.

PUCCI, Luiz F. S. **UMA INTRODUÇÃO À ASTRONOMIA E À EXPLORAÇÃO ESPACIAL** Laborciência, São Paulo, 1997.

RIDPATH. I, **ASTRONOMIA,** GUIA ILUSTRADO ZAHAR, 2ª edição, tradução Maria Luiza X. de A. Borges. Jorge Zahar Editor, Rio de Janeiro, 2006.

SAGAN, Carl. **PÁLIDO PONTO AZUL**: uma visão do futuro da humanidade no espaço. Tradução: Rosaura Eichemberg. Companhia das letras, São Paulo, 1996.

STOTT, Carole. **O GUIA DO ASTRÓNOMO**; guia prático para experiências e técnicas de observação do céu. Tradução: Mafalda Morais Marques. Civilização, Lisboa, Portugal, 1999.

VIEGAS, Sueli M. M & DE OLIVEIRA, Fabíola, Organizadoras. **DESCOBRINDO O UNIVERSO.** Edusp. São Paulo, 2004.

RIDPAH, I, **GUIA ILUSTRADO ZAHAR – ASTRONOMIA**: Estrelas. Planetas. Constelações. Observação. 2ª edição – Jorge Zahar editor. Rio de Janeiro, 2008.

SITES.

www.on.br

www.zenite.br

http://www.zenite.nu

starrynight.com

skayandtelescope.com

www.lmsc.lokheed.com/HST

http://www.bing.com/images/search?q=Sol&FORM=BIF-D#focal=a711fb04117277429809545a2db3cc97&furl=h-ttp%3A%2F%2Fimg.genciencia.com%2FSol.jpg

http://www.bing.com/images/search?q=Lua&FORM=BIFD#

cd. O UNIVERSO – Observatório Nacional

http://1.bp.blogspot.com/_HQkcETOFQ7Q/R4vBx-UgbGI/AAAAAAAAAcc/xK8rTP13zkE/s400/Sistema+Solar.jpg%2Bsolar%26gbv%3D2%26nds-p%3D20%26hl%3Dpt-BR%26sa%3DN%26start%3D20

http://images.google.com.br/imgres?imgurl=http://www.prof2000.pt/users/cfqfespan/sistema%2520solar.jpg&imgrefurl=ht-tp://www.prof2000.pt/users/cfqfespan/plutao.htm&usg

http://mauroluism.zip.net/images/sistema_estelar_escala_2_470.jpg=__iU8dDhyhOPoCFJCRZpguasYHkrw=&h=720&w=1280&sz=84&hl=p-t-BR&start=8&tbnid=OluU0dbMjgv3TM:&tbnh=84&tbnw=150&prev=/images%3Fq%3Dsistema%2Bsolar%26gbv%3D2%26hl%3Dpt-BR

http://calendario.incubadora.fapesp.br/portal/introdu-cao/imagens/estrelas.jpg/image_preview

http://media.photobucket.com/image/os%20pla-netas/ricardoastronomo/3Planetas.jpg

http://images.google.com.br/imgres?imgurl=http://www.fisicastronomorais.com/Imagens4/Untitled-4%2520copy.gif&imgrefurl=http://anunciacaorrocha.googlepages.com/ci%25C3%25AAnciasnaturais=7-25%2C25%BAano&usg

__1gUvbO7ntqMweOjbEHcFkWQITus=&h=520&w=520&sz=43&hl=p-t-BR&start=32&tbnid=RuQZRETrYOp6oM:&tbnh=131&tbnw=131&prev=/images%3Fq%3DModelo%2Bgeoc%25C3%25AAntrico%26gbv%-3D2%26ndsp%3D20%26hl%3Dpt-BR%26sa%3DN%26start%3D20

falandofotos.blogspot.com/2009/02/tamanho-ter...

http://br.geocities.com/saladefisica7/funciona/foguete.htm

http://www.cosmobrain.com.br/res/meteoros.html

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7. http://villarrubia.wordpress.com/galeria-fotogragfica/mis-personajes-favo-ritos-algunos/35

12. Artistic conception of the Inácio Araújo de Medeiros For the total eclipse of the sun seen in Natal, visto em Natal in March, 29, 2006

32 . José Adriano Brito de Lima

35. Nelson Íon de Oliveira

37 blogummagumma.blogspot.com/2009/08/pensamento..

38 http://amoreodio.files.wordpress.com/2008/01/sol07.jpg

39 : www.mundoatual.t5.com.br/page_1178746482990.html

40 www.portaldoastronomo.org/tema_pag.php?id=38...

41 www.fisicastronomorais.com/avintrod6.htm

45 a 48: Astronomia no Zênite

49 www.egrupos.net/.../archivo/indice/1/msg/32/

50 . http://fisicamoderna.blog.uol.com.br/arch2004-10-24_2004-10-30.html

51.http://calendario.incubadora.fapesp.br/portal/introducao/imagens/estrelas.jpg/image_prev

52 a 54 – were autorized by José Carlos Diniz

orbita.starmedia.com/.../diniz/foto9.htm

orbita.starmedia.com/.../diniz/foto1.htm

ATTACHMENTS

ATTACHMENT 1

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In 2005, due to the creation of a special Research and Innovation Board, the IFRN Publishing House was founded. The idea since then was to offer a wider space to display the studies of the institutional researchers in order to achieve a much wholer community.

Up from its own funding, or from projects presented by research centers, the moto is to publish books with proven relevance regarding the development of universal science and culture, from a wide range of areas and from other institutions, always highlighting a policy whose priority is one´s quality.

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The works carried out in the project Astronomical Journeys were done within an environment of friendship and respect between teachers and students in a certain way that everybody knew and did their activities without any demands at all from them. Our communication in all the process was through a so nice language as the brightness of the stars, in other words, a sublime language.

The sublime language

The language of affectivity and reason is not written in books, newspapers, magazines and not even spoken in any means of communication. When we communicate with this language, the words got lost in the emptiness, the attitudes speak for themselves. It's the biggest expression of feelings which makes overflow the most sublime moments of tenderness.

(Antônio Araújo)

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