Astronomical Measurements in Ancient Greece (project TF2E)

Final report

Introduction – Project goals

Although it is not widely known to students and the public, the ancient Greek philosophers had made a number of accurate astronomical measurements and created successful models in an effort to describe the wonders of the Cosmos. With the power of the human mind they carried out reasonable estimates of the sizes of the earth, the moon and the sun and the distances of the sun and moon from the earth.

This project's aim is two-fold.

Firstly it aims at bringing this knowledge to the secondary education students, who, by carrying out these measurements, will appreciate how an innovative mind can explore the universe from our little planet. The students will carry on exploring the universe beyond the earth, moon and sun and by analysing their observations will evolve their knowledge of the universe and change any alternative ideas held to the scientific accepted ones.

Secondly, it is this project's aim to support these students in reaching out the community and spreading this knowledge to the public so that everyone can realize that the cosmos is not far out of reach but is within everybody's grasp to explore it even from their own backyard, as the Ancient Greek astronomers did.

1. Short summary

A series of workshops was designed to support students of the senior High School (called Lyceum) of Nea Zichni to get acquainted to the acomplishments of ancient Greek philosophers regarding astronomy. The students were taught according to this teaching-learning sequence and made measurements of the size of the Earth, the size and the distance of the Moon, and the size and the distance of the Sun. At the end of the spring term the participating students formed a report on the work they did in the project.

An 8-inch telescope was purchased with the appropriate accessories for observing the Moon, the Sun, the solar planets and other objects of the night sky and taking images of them. It was used by the students to observe sunspots during daytime and for other sky objects during nightime.

In the context of another environmental project, which also was carried out at our school, an excursion to the city of Kastoria was made, at which students from this project participated. A small portable telescope lent to us by the Center of Natural Sciences of Serres was carried there but during our stay in Kastoria heavy clouds were covering the sky not allowing for any descent observations.

Two short evaluation tests were constructed; one for measuring the students' conceptual evolution throughout the project and one for measuring the students' attitude towards astronomy. They were put together in a single looking test and were administered to the students at the beginning of the project (pre-test), at the end of the spring term as a mid-test and at the end of the fall term (post-test). The results were compared among the three instances to determine the successfulness of the project for the students of our school. This test is presented at the end of this report.

The participating students visited neighbouring schools and presented their work and experience with the project. They also raised interest for astronomy inside our school by

presenting their work to the rest of our school students, too. The same evaluation tests were also completed by students of all these schools before and after our students' presentation to check for either an increase in field knowledge understanding or attitude change towards astronomy. The students' answers were processed and the results are presented in section 3.

A web site has been created for the project which presents the objectives, the events and other information relevant to the project. The address of the site is

http://lyk-n-zichn.ser.sch.gr/ADMire

and the site was constantly updated and enriched with new material as the project evolved.

The project participated in the summer festivities of the local municipality by organizing an open astronomy evening. During the event, which took place on 16th July, Asst. professor K. Tsiganis gave an invited talk, our school students' work was presented to the public and a local amateur club called Astropili provided telescopes, which, together with our school telescope guided people from the local community to the wonders of the Universe. The event was a great success and will be repeated every summer and on other possible occasions.

Our telescope was equipped with a secondary guiding system to lock upon stars and provide stable guidance to the telescope, necessary for carrying out astrophotography. This allowed our students to take pictures of constellations and deep sky objects during the fall term. An introduction to the standard data reduction techniques was also given on using bias, dark and flat frames. The best images of our student efforts on some night sky objects are published at the project's website.

2. Reaching our goals

The first goal of the project was accomplished by incorporating the project in the context of the Spring Term course of the Greek curriculum called "Project". Within this course 19 students learned the fundamental elements of earth and sky motion and attempts were made to restore any misconceptions inherited by their surroundings. Measurements of the sizes of the Earth, Moon and Sun and their distances were carried out and observations of the sun at normal class hours and sky observations at evening sessions were made.

To evaluate the students' field knowledge evolution as well as to check for attitude changes two short tests were constructed. They were put together in a single looking test and were administered to the participating students at the beginning of the project (pre-test), at the end of the spring term as a mid-test and at the end of the fall term (post-test). This test is presented in the end of this report.

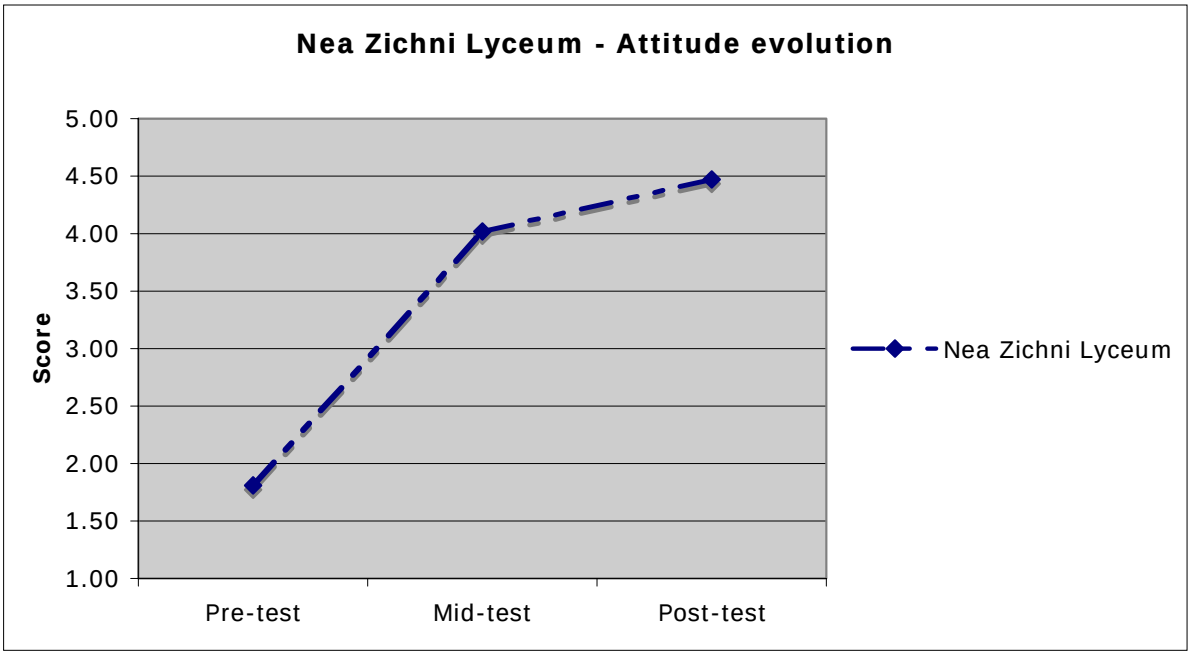
The first five questions were testing the students' attitude towards astronomy. A five level rubric was used to score the answers to these questions. Each answer received score points equal to the level of the rubric indicated by the student, namely 1, 2, 3, 4 or 5. Since in the last three questions of this test the highest score was showing a high dislike for astronomy, these three question scores were reversed for the final calculation of the score of the students in the attitude test.

The remaining eight questions were testing the field knowledge of the students in the specific areas which were discussed within the context of this project. Each answer was evaluated independently by two teachers and rated from 0 to 1 according to the correctness and completeness of the answer. This scale was composed of eleven levels, namely 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.

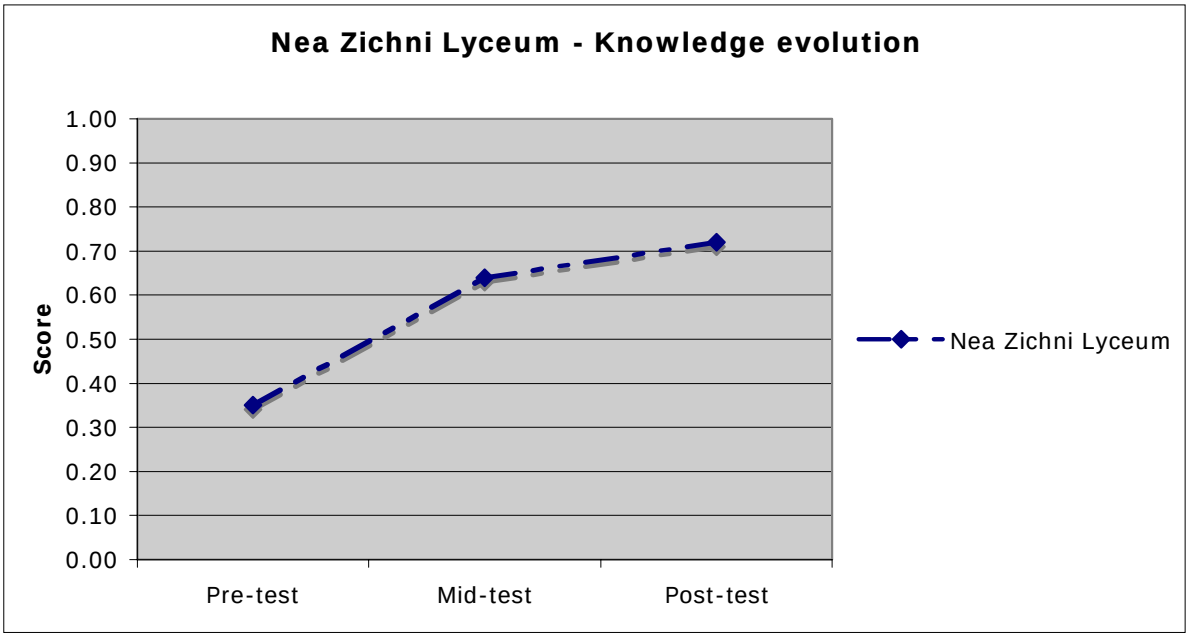
The students' scores were averaged for every test instance and were compared among the three instances to determine the successfulness of the project for the students of our school who participated in the project. The average students' scores are shown in the following table and are graphically represented in Pictures 1 and 2.

Nea Zichni Lyceum	Pre test	Mid test	Post test
Attitude	1.81	4.02	4.47
Field knowledge	0.35	0.64	0.72

Table 1. Average student scores for the participating students of Nea Zichni Lyceum



Picture 1. The participating students' attitude evolution throughout the project



Picture 2. The participating students' field knowledge evolution throughout the project

A significant improvement is observed in both the students' attitude towards astronomy and their relevant field knowledge throughout the whole project duration. This improvement is also verified by a statistical analysis through paired samples t-tests comparing pre- and mid-test scores, mid- and post-test scores and pre- and post-test scores. All tests show that the case for no improvement in any comparison can be rejected with greater than 99% confidence.

The improvement seems to be great in the first part of the project (from pre-test to mid-test) and quite small in the second part (from mid-test to post-test), as can be shown from the above graphs. This can be attributed to the fact that the initial scores in the pre-test were low, allowing for a great improvement afterwards, whereas the mid-test scores were above the middle point of the corresponding scales allowing for only modest improvements. To correct for this effect and better assess the improvement on both parts of the project we calculated the so-called Hake gain for both the attitude and field knowledge improvement in mid and post-tests. The Hake gain is defined as the normal gain divided by the maximum gain which can be achieved in each case:

Hake gain = (final score – initial score) / (maximum score – initial score) X 100%

and the average Hake gains for both the attitude and field knowledge tests are shown in table 2.

Nea Zichni Lyceum	Pre test to Mid test Hake gain (%)	Mid test to Post test Hake gain (%)	Pre test to Post test Hake gain (%)
Attitude	69.28	45.92	83.39
Field knowledge	44.62	22.22	56.92

Table 2. Hake gains for the participating students of Nea Zichni Lyceum

In essence, Hake gain shows the percentage of students who changed attitude towards astronomy or corrected their initial knowledge about astronomy during the project. Hake gains below 30% are considered to be small , between 30% and 60% are considered to be of medium level to significant and above 60% are considered to be very significant.

As can be seen from the above table, there is a very significant total attitude improvement towards astronomy throughout the whole project. This improvement was mostly accomplished in the first part, but also appeared during the second part. This is expected since the excitement produced by the initial contact with a subject such as astronomy is likely to drive an initial wave of positive attitude towards astronomy. This attitude improvement will then decline but will remain present as students gain a better understanding of the subject and get engaged in challenging activities, like astrophotography.

A similar trend is also observed in the field knowledge evolution: there is a greater improvement in the first part of the project and a smaller one in the second part. This is expected since there was no new knowledge offered to the students in the second part and the improvement can only be attributed to the fact that the students used some of their knowledge again and thus acquired a better understanding.

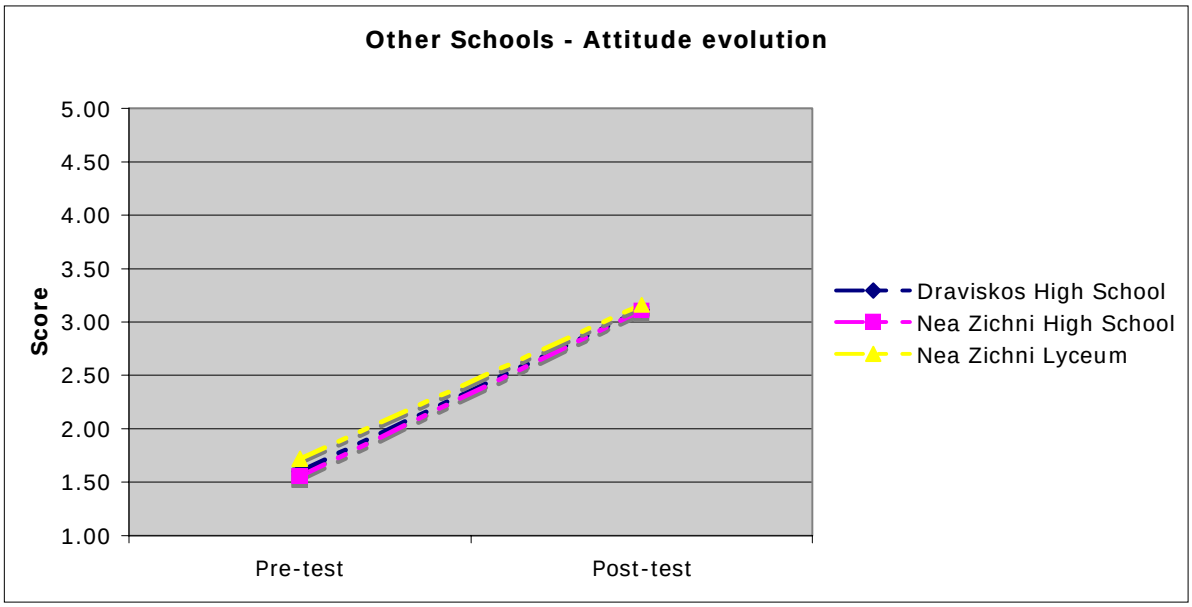
The second aim was accomplished by supporting the participating students along with invited university experts to present their techniques and findings at a series of public lectures to the students of the other schools of the district and the local community during the local cultural festivities in the summer of 2013. The participating students presented their work to the rest of the students in their class, students of the Draviskos High School and students if the Nea Zichni high School. All these students completed the same

attitude and field knowledge test before and after the presentation and their answers were scored as described above.

These students' scores were averaged for every test instance and were compared among the two instances to determine the successfulness of the project for the students of our school who did not participate in the project and the students of the other two schools. The average students' scores are summarized in the following table and are graphically represented in Pictures 3 and 4.

	Pre test	Post test
Nea Zichni Lyceum		
Attitude	1.72	3.16
Field knowledge	0.31	0.40
Draviskos High School		
Attitude	1.60	3.11
Field knowledge	0.26	0.34
Nea Zichni High School		
Attitude	1.56	3.10
Field knowledge	0.23	0.31

Table 2. Average student scores for the non-participating students of Nea Zichni Lyceum and the students of the Draviskos and Nea Zichni High Schools

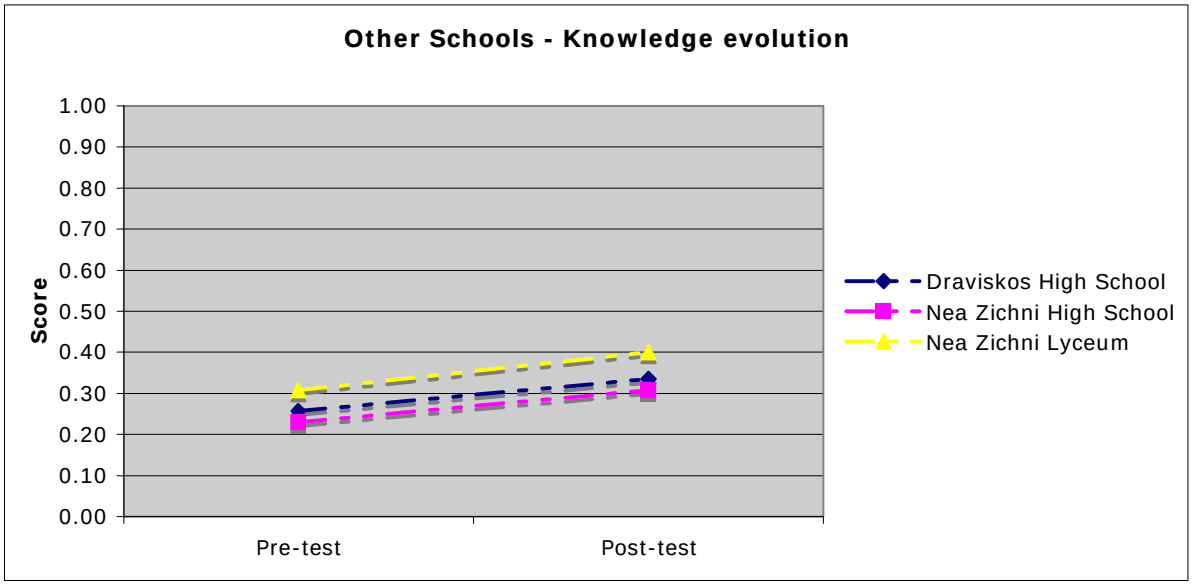


Picture 3. Attitude evolution of students not participating in the project

It is evident from these results that there exists a significant improvement in the attitude towards astronomy of all students exposed even briefly through one lecture to astronomy. This improvement is also verified through a statistical analysis of the students scores with a paired samples t-test from pre to post-test for all three schools at the 99% confidence level. The corresponding Hake gains are shown in Table 3.

The field knowledge evolution does now show such an improvement. This is expected since there was only one lecture fiven to them by our students. A statistical analysis with paired samples t-tests, however, reveals that this very small improvement is real at a significance level of 99%. This is attributes to the fact that most of the students showed a small but steady improvement of their test scores with very few decreases, which

statistically yields an effect with high confidence. The corresponding Hake gains for the field knowledge evolution are also shown in Table 3.



Picture 4. Field knowledge evolution of students not participating in the project

	Pre- to post- test Hake gains
Nea Zichni Lyceum	
Attitude	0.44
Field knowledge	0.13
Draviskos High School	
Attitude	0.44
Field knowledge	0.11
Nea Zichni High School	
Attitude	0.45
Field knowledge	0.10

Table 3. Hake gains of students not participating in the project

Overall the above results show a remarkable success of the project in raising the students' interest and knowledge in astronomy. In particular, the students were stimulated in getting engaged in scientific activities related to astronomy and observing and taking pictures of sky objects through a telescope. This resulted in a increase in their interest about astronomy and subsequently in an increase in their related field knowledge. This is also evident from the students' small essays about their experience with the project, which are published in the project's web site. Furthermore, this excitement was also passed to the local community through the students' families (a couple of citizens owing telescopes contacted the school in an effort to organize more observing nights) and through the presentation of the students' work in the local summer festivities.

3, 4 and 5. Deviations and challenges. Recommendations for improving the impact of the project

The original planning for the project was closely followed with no deviations during implementation. The students participated promptly and were very excited to be part of the

project. This made the implementation easy and no significant problems were faced. The greatest challenge was to get the students to present their work to other students and the rest of the local community. This proved only partially successful since the participating students did make their presentations to other students in our school and other high schools, but did not present the project themselves publicly in front of the rest of the community in the astronomy day in the summer festivities. This was finally presented to the public by the coordinator of the project with the students being among the audience.

A restriction of this project is that it dealt with only a very small part of astronomy and the participating students were only partly exposed to the astronomical knowledge. A more systematic approach, with a regular astronomy course and hands-on activities with the telescope both at class hours and at evening sessions would greatly enhance the students' acquired knowledge and their abilities to carry out observations. There are plans to connect the school computer laboratory with the telescope so that it can be placed at the roof of the building and people from inside the school can remotely access it and observe sky objects without climbing on the roof of the school at night (only positioning of the telescope is currently supported with remote operation of camera and CCD but without any remote focus support). Furthermore, if the above approach is applied to high school students, who are not as heavily burdened with classes as Lyceum students, and can work on astronomy for 4-5 years before leaving school to enter university, stable groups of students can be formed which can act as bright active nuclei attracting others to the group. Unfortunately the students who participated in this project were already in the second grade of Lyceum during the school year 2012-2013 and this school year (2013-14) are very busy preparing themselves for the pan-Hellenic exams for entering the university. For this reason, students from the first grade of our school also participated in astrophotography, in the last part of the project in the fall term.

Despite these deficiencies, the project was very successful and accomplished all its goals, as was discussed in the previous section of this report. It is due to this success that activities of this project will continue to be implemented in the following years, like earth radius measurements, evening sky observations and astrophotography and summer astronomy nights, even without having any formal obligation. Furthermore, the cooperation with neighboring high schools will be tightened in all the above activities with the aim to form groups of students actively interested in astronomy. Cooperation will also be strengthened with Astropili, a club of amateur astronomers in Serres, who are trying to raise interest for astronomy among the students of the Technological Education Institute of Serres and the citizens of the city along with the local UNESCO branch.

6. Recommendations for expanding the project

As mentioned above, although the project formally reached completion at the end of 2013, it will be continued over the next years with other students coming to the Nea Zichni Lyceum. It will also be expanded to the neighboring high school students through cooperation with physics teachers of these schools and equipment sharing so that students will appreciate the beauty of astronomy sooner and will be more actively involved in astronomical activities.

At a later stage perhaps a local network of schools and other groups of people interested in astronomy, like Astropili, could be formed, which can coordinate astronomical events and facilitate equipment sharing throughout the whole county of Serres. A web site containing astronomical information on objects, techniques and events, providing access to services like equipment sharing or remote observing and facilitating communication between

members of the astronomy network could act as the link bringing together all those people interested in astronomy and promoting astronomy development locally.

Such a web portal could also act as a link in uniting other similar efforts thoughout the globe and facilitate communication among groups which can thus become parts of an international network of schools, universities, research organizations and various groups promoting the development of astronomy worldwide. The OAD can be a vital part of this network, which can initially be formed by the groups which have been supported so far in implementing astronomy oriented projects. This international network would mostly facilitate the exchange of information (scientific, technical, observational, computational etc), the implementation of remote observations through the use of remotely operated fully automated telescopes, the mobility of people through visitor exchange programs and cooperation among people from all over the world in carrying out international projects, such as measuring the earth radius by doing simultaneous object shadow measurements in varius places on the earth.

7. Financial report

Below is a table summarizing the financial management of the project (all costs include taxes).

Date	Invoice	Reason	Cost	Remarks
7 Feb. 2013	821-06-1142543-G	Received Grant	3000,00	Grant for TF2E project from OAD through ABSA, a member of the Barclays group
7 Feb. 2013	821-06-1142543-G	Bank commission	13,00	Commission of ABSA (0,44% of 3000 euro = 13,2 euro, charged 13,00 euro)
27 Feb. 2013	96 – Κακαρίδης Χ. Άγγελος	3-day excursion to Kastoria (for an environmental project and astronomical observations).	400.00	The trip cost 750.00 euros, 350.00 of which were paid by the environmental project which was also funding the excursion. The accommodation expenses in Kastoria and insurance expenses were paid in full by the environmental project.
14 Mar. 2013	04758010100067221 – ΕΛΤΑ for ΠΛΑΙΣΙΟ Computers ΑΕΒΕ	Camera purchase	299,00	Nikon D3000 with a 18-55 VR automatic lense.
13 Apr. 2013	ΑΕΠ-ΤΧ-00135 – ΤΣΑΜΠΟΥΡΑΣ ΔΗΜΗΤΡΙΟΣ & ΣΙΑ Ο.Ε.	Telescope purchase	1701,00	Telescope SkyWatcher 200mm, Celestron CG-5 mount, neximage 5 CCD camera, filters, adaptors and lenses.
13 Apr. 2013	ΑΕΠ-ΤΧ-00136 – ΤΣΑΜΠΟΥΡΑΣ ΔΗΜΗΤΡΙΟΣ & ΣΙΑ	Binoculars purchase and transportation	139,00	Celestron skymaster 15x70 binoculars

	Ο.Ε.	costs		
8 Jul. 2013	002667 – Σιδηρόπουλος Κων. Δημήτριος	Electric cable 50m purchase	44,90	Electric cable 50m for operation of the telescope far from the school building
8 Jul. 2013	787 – Χατζηκαλλία Καμ. Δήμητρα	Memory card purchase	7.63	Memory card for use with the Nikon camera (By mistake the invoice also contains network cables, not associated with this project – only the memory card cost which is 7.63 euros is written in the column for the cost of this invoice instead of the total of 19.93 euros)
17 Jul. 2013	5655 – HOTEL LEON Όλγα Χανοζίδου & ΣΙΑ ΕΕ	Accomodation for invited speaker	30,00	Accomodation for invited speaker. Meal and transportation expenses were provided by the municipal.
27 Aug. 2013	810 – Χατζηκαλλία Καμ. Δήμητρα	Telescope-laptop interface cables	22.50 (cost is 23.37 with 0.87 discount)	Two USB cable extensions for remote control of our Nikon and Neximage cameras from a laptop, 30m network cable for network connectivity of the laptop used to control the telescope with the school network. (By mistake the invoice also contains a network switch and electric switches, not associated with this project – only the USB and network cable costs which are 23.37 euros is written in the column for the cost of this invoice instead of the total of 50.00 euros)
30 Aug. 2013	ΤΔΑ-Τ-00312 – ΤΣΑΜΠΟΥΡΑΣ ΔΗΜΗΤΡΙΟΣ & ΣΙΑ Ο.Ε.	Finder purchase	121,00	Finder to be used as a secondary guiding system along with the CCD camera already purchased
30 Aug. 2013	ΤΔΑ-Τ-00313 – ΤΣΑΜΠΟΥΡΑΣ ΔΗΜΗΤΡΙΟΣ & ΣΙΑ Ο.Ε.	Finder mount, polar finder and astrophotography book purchase	129,00	Finder mount for secondary guiding system, polar scope for accurate polar alignment and astrophotography book for working on astrophotography with students in the fall 2013 term.
27 Sep. 2013	160 – Ι. ΙΑΤΡΙΔΗΣ-Β. ΜΠΟΥΤΣΙΟΥ Ο.Ε.	Summer event catering	92,97	Late invoice for refreshments treats and consumables of our astronomy night at the

				summer festivities.
31 Dec. 2013	**Total expenses**		3000,00	Total income 3000,00

The rest of the expenses for the summer festivities (sound system hire, lights, printed material etc) were paid by the local municipal authorities. Also, the invited speaker meals and travel expenses and telephone costs and other printing material of the project were provided by the secondary schools committee of the local municipal of Nea Zichni provided that a similar amount of money from the grant will be spend on purchasing accessories for the telescope of the school. This is the reason that at the end of the summer the telescope was equiped with a secondary guiding system and a polar scope to provide accurate telescope guidance for astrophotography.

8. Copies of invoices and receipts

The invoices and receipts mentioned in the table of section 7 are included in the following pages 11 to 28.

9. Project resources

Materials produced specifically for this project and used throughout this project include the worksheet used by the students to carry out and complete their measurements, the test administered to the students to evaluate their attitude towards astronomy and their field knowledge in the areas addressed by this project and the presentations created by the students to disseminate their work. This material is also included in the pages after page 29 following the invoices and receipts. At the end, short statements in English from the students about their experience with the project are also included. More material about the project, like photographs of students at work, photographs of astronomical objects taken by the students (Sun, planets, stars, constellations, deep sky objects) and other information is available in the project's website at the address

http://lyk-n-zichn.ser.sch.gr/ADMire

Acknowledgements

All the students and the teachers participating in this project would like to thank the Office of Astronomy for Development (OAD) of the International Astronomical Union (IAU) and especially Kevin Govender and J.C. Mauduit for their financial and moral support in realizing this project and letting us experience this journey to our Universe over the past year. Be assured that we will continue to frequently visit the skies through the window you've helped us open to the Cosmos.

INVOICES and RECEIPTS

Member of the BARCLAYS Group

ABSA

ITC Pretoria
6th Floor Volkskas Building
230 Lilian Ngoyi (Van der Walt) Str
Pretoria 0002 RSA
Pretoria 0002 RSA
V.A.T. Reg. No: 4940112230
Facsimile No : 012 317 0011
Contact Person: Katlego Legodi
Telephone No : 0123666079

7 February 2013

To : SOUTH AFRICAN ASTGRONOMICAL OBSERVATORY
Attention : MRS G SNOWBALL

OUTWARD REMITTANCE: CONFIRMATION OF PAYMENT

Our Reference No : 821-06-1142543-G
Your Reference No : GENERAL LYCEUM OF NEA ZICHNI
Related Transaction : 0705TRO130200535
Payment Amount : EUR 3,000.00
Value Date : 08.02.2013
Beneficiary : GENERAL LYCEUM GENERAL NEA ZICHNI
CFC Transaction Type : Transfer Out
: Bop summary for SARB REF NO: 8210611425430002

Total Original amount : 3,000.00 Original Curr: EUR

SEQ No	Original Amount	Original Curr	Sub Category
01	3,000.00	EUR	Tuition Fees

In accordance with your instructions, we confirm having settled the above transaction as follows:

Account number 550144514 debited with the sum of ZAR247.80 for value 08.02.2013, as detailed hereunder.

Account number 550144514 debited with the sum of ZAR36,901.50 for value 08.02.2013, as detailed hereunder.

Our Reference No 821-06-1142543-G (Continued)

Details of Settlement and Charges:

Communication Charges	ZAR	55.00
Standard Rated VAT	ZAR	7.70
Commission EUR 3,000.00 Commission 0.44% on EUR 3,000.00 = EUR 13.20 Rate 12.3005	ZAR	162.37
Standard Rated VAT	ZAR	22.73
Transaction Amount EUR 3,000.00 Rate 12.3005	ZAR	36,901.50
In total we debit	ZAR	37,149.30

Additional Information

0705TRO130200535

Please quote our Reference Number 821-06-1142543-G in all future correspondence relevant to this transaction.

If we can be of any further assistance in this regard, please do not hesitate to contact us.

Absa must comply with national and international laws, regulations, policies, rules and requirements to prevent criminal activities, money laundering and terrorist financing, sanctions and prohibited business activity laws and rules violations. Absa must therefore check all information from and about you and related parties, monitor, verify, process and screen your and related party information, instructions and transactions on an ongoing basis. This may cause some delays or the limitation or the prohibition of transactions that you make or accounts you apply for. We may also have to end our relationship with you without warning.

Absa is not responsible for any losses or damages that you may suffer because of these checks or by Absa ending the relationship. This includes any loss of profits or savings that

you would otherwise have expected to make.

If this instruction and/or any of goods and/or services provided under this instruction are governed by the Consumer Protection Act 68 of 2008, and/or the National Credit Act 34 of 2005, it is not intended that any provision of this instruction contravenes any provision of the Consumer Protection Act or the National Credit Act , as the case may be and therefore all provisions of this instruction must be treated as being qualified , if necessary , to ensure that the provisions of the Consumer Protection Act and/or the National Credit Act, as the case may be are complied with.

This is a computer-generated advice and does not require any signatures.

ΚΑΚΑΡΙΔΗΣ Χ. ΑΓΓΕΛΟΣ
ΓΡΑΦΕΙΟ ΓΕΝ. ΤΟΥΡΙΣΜΟΥ & Τ.Ε.Ο.Μ.
29ης ΙΟΥΝΙΟΥ 5 - ΣΕΡΡΕΣ
ΤΗΛ. & FAX 2321027477
ΑΦΜ 074319632 - Α' ΔΟΥ ΣΕΡΡΩΝ

Νο 96

Ημερομηνία 21 | 2 | 2013

ΤΙΜΟΛΟΓΙΟ (για παροχή υπηρεσιών)

ΠΕΛΑΤΗΣ: ΓΕΛ Ν. ΣΙΧΝΗΣ **ΑΦΜ:** 090384085

ΕΠΑΓΓΕΛΜΑ: **ΔΟΥ:** Α' ΣΕΡΡΩΝ

ΔΙΕΥΘΥΝΣΗ: Ν. ΣΙΧΝΗ **ΠΟΛΗ:** Ν. ΣΙΧΝΗ

ΑΡΙΘΜΟΙ ΔΕΛΤΙΩΝ ΑΠΟΣΤΟΛΗΣ

ΕΙΔΟΣ ΠΑΡΑΣΧΕΘΕΙΣΗΣ ΥΠΗΡΕΣΙΑΣ	ΔΑΠΑΝΗ ΓΙΑ ΛΟΓΑΡΙΑΣΜΟ ΤΟΥ ΠΕΛΑΤΗ	ΑΜΟΙΒΗ	ΣΥΝΟΛΟ
ΝΑΥΛΩΣΗ ΛΕΩΦΟΡΕΙΟΥ ΓΙΑ ΤΗΝ ΜΕΤΑΦΟΡΑ ΤΩΝ ΜΑΘΗΤΩΝ ΤΟΥ Γ.Ε.Λ. Ν. ΣΙΧΝΗΣ ΣΤΗΝ ΚΑΣΤΟΡΙΑ ΑΠΟ 21-2 ΕΩΣ 23-2			663,72

Πληρωτέο ποσό ολογράφως:

ΕΦΤΑΚΟΣΙΑ ΟΓΔΟΝΤΑ ΕΥΡΩ

ΜΕΤΡΗΤΟΙΣ [X]

ΜΕ ΠΙΣΤΩΣΗ [ ]

ΑΞΙΑ ΠΡΟ ΕΚΠΤΩΣΗΣ	
ΕΚΠΤΩΣΗ %	
ΑΞΙΑ ΜΕΤΑ ΤΗΝ ΕΚΠΤΩΣΗ	663,72
ΦΠΑ 13 %	86,28
ΠΛΗΡΩΤΕΟ ΣΕ €	750 €

ΓΙΑ ΤΗΝ ΕΚΔΟΣΗ

ΛΕΥΚΟ - πελάτης (δεν αποτελεί συνοδευτικό μεταφοράς) / ΚΙΤΡΙΝΟ - στέλεχος (δεν αποτελεί συνοδευτικό μεταφοράς)

ΠΛΑΙΣΙΟ COMPUTERS A.E.B.E.
ΕΔΡΑ: ΘΕΣΗ ΣΚΛΗΡΗ, 19018, ΜΑΓΟΥΛΑ

ΤΟΠΟΣ ΑΠΟΣΤΟΛΗΣ ΚΑΙ ΕΚΔΟΣΗΣ
ΘΕΣΗ ΣΚΛΗΡΗ ΜΑΓΟΥΛΑ 19018

ΑΘΗΝΑ - ΘΕΣΣΑΛΟΝΙΚΗ - ΠΑΤΡΑ - ΗΡΑΚΛΕΙΟ - ΛΑΡΙΣΑ

ΑΘΕΩΡΗΤΑ ΒΑΣΕΙ ΤΗΣ Α.Υ.Ο. Π.Ο.Λ.-1083/2.6.2003
Α.Φ.Μ.: 094222211 - Δ.Ο.Υ.: ΜΕΓΑΛΩΝ ΕΠΙΧΕΙΡΗΣΕΩΝ
ΑΡ. ΜΑΕ: 16601/06/Β/88/13
ΑΡ. ΜΗΤΡ. ΠΡΟΜ. 176/2001
Α.Μ.Π.: 00301

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ΠΑΡΑΣΤΑΤΙΚΟ

ΣΕΙΡΑ: ΤΔ431 ΑΡΙΘΜΟΣ: 1974320

2443059 **ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ**

ΚΩΔΙΚΟΣ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΩΝΥΜΙΑ: ΣΧΟΛΕΙΑ
ΕΠΑΓΓΕΛΜΑ: ΝΕΑ ΖΙΧΝΗ ΣΕΡΡΩΝ
ΔΙΕΥΘΥΝΣΗ:

ΠΟΛΗ: ΣΕΡΡΩΝ ΣΕΡΡΕΣ
ΠΕΡΙΟΧΗ: EL090384085 Τ.Κ. 62042
Α.Φ.Μ.: Α' ΣΕΡΡΩΝ
Δ.Ο.Υ.:

ΣΤΟΙΧΕΙΑ ΠΑΡΑΣΤΑΤΙΚΟΥ

ΣΧΕΤΙΚΟ ΠΑΡΑΣΤΑΤΙΚΟ:
ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ: Πώληση
ΩΡΑ ΦΟΡΤΩΣΗΣ: 06:00:00 ΤΑΜΕΙΟ: EHR
ΚΙΝΗΣΗ ΣΥΣΤΗΜΑΤΟΣ: 201395161
ΔΕΜΑΤΑ: 1 4028377986
ΠΟΣΟ ΠΡΟΣ ΕΙΣΠΡ.:
ΑΡ.ΕΝΤ.ΠΕΛ:

Για λογ/μό: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
Υπ. Παρ/λίας:

ΤΟΠΟΣ ΠΑΡΑΔΟΣΗΣ

ΟΔΟΣ/ΑΡΙΘ.: ΝΕΑ ΖΙΧΝΗ ΣΕΡΡΩΝ
ΠΕΡΙΟΧΗ...: ΣΕΡΡΕΣ ΤΚ: 62042
ΝΟΜΟΣ.....: ΣΕΡΡΩΝ
ΔΡΟΜΟΛΟΓΙΟ: 1098

ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΠΑΡΑΛΑΒΩΝ.....: ΚΟς ΤΑΡΑΜΟΠΟΥΛΟΣ
ΤΗΛΕΦΩΝΟ.....: 2324022204-6973847069
ΚΤΙΡΙΟ-ΟΡΟΦ-ΔΩΜ.: --

ΣΧΟΛΙΑ

- Εντολέας: Πλαίσιο - Έξοδα αποστολής: Επιβαρύνουν την Πλαίσιο Computers
ΕΧΕΙ ΠΙΣΤΩΣΕΙ: 299,00 Euro Αντικαταβολή - Πληρωτέο με την παράδοση (ΜΕΤΡΗΤΑ) ***
ΜΕΤΑΦΟΡΕΑΣ: ΕΛΤΑ ΤΑΧΥΜΕΤΑΦΟΡΕΣ ΑΕ , ΔΙΕΥ.: ΔΗΜΗΤΡΙΟΥ ΓΟΥΝΑΡΗ 40 , ΤΚ: 15343 , ΠΟΛΗ: ΑΓ. ΠΑΡΑΣΚΕΥΗ , ΠΕΡΙΟΧΗ: ,
ΤΗΛ: 2106073000-6073026

ΑΛΛΑΓΕΣ 9.00 - 11.00 ΜΕΣΑ ΣΕ 20 ΜΕΡΕΣ ΜΟΝΟ ΜΕ ΤΗΝ ΠΡΟΣΚΟΜΙΣΗ ΤΟΥ ΔΕΛΤΙΟΥ

ΠΩΛΗΤΗΣ	ΚΩΔ.	ΧΡΩΜΑ	ΠΕΡΙΓΡΑΦΗ ΕΙΔΟΥΣ	ΜΟΝ. ΜΕΤΡ.	ΠΟΣΟΤΗΤΑ	ΣΥΝΤ. Φ.Π.Α.	ΤΙΜΗ ΜΟΝΑΔΑΣ ΧΩΡΙΣ Φ.Π.Α.	ΤΙΜΗ ΜΟΝΑΔΑΣ ΜΕ Φ.Π.Α.	ΠΟΣΟΣΤΟ ΕΚΠΤΩΣΗΣ/ΕΠΙΒΑΡΥΝΣΗΣ	ΚΑΘΑΡΗ ΑΞΙΑ	ΣΥΝΟΛΙΚΗ ΑΞΙΑ ΜΕ Φ.Π.Α.
0307	1335197		DIGITAL CAMERA NIKON D3000 18-55mm VR	ST	1	23	243,09	299,00		243,09	299,00
			-Το προϊόν 1335197 συνοδεύεται με 2 Έτη εγγύηση Αντιπροσωπείας								

% Φ.Π.Α.	ΟΛΙΚΗ ΑΞΙΑ	ΕΚΠΤΩΣΗ	ΕΠΙΒΑΡΥΝΣΗ	ΥΠΟΚΕΙΜΕΝΗ ΣΕ Φ.Π.Α. ΑΞΙΑ	Φ.Π.Α.	ΣΥΝΟΛΟ
23	243,09			243,09	55,91	299,00

Εκδόθηκε από: Emanouil Christakis
06:00:00
Ο ΠΑΡΑΛΑΒΩΝ

ΠΛΗΡΩΤΕΟ ΠΟΣΟ
EURO:
******299,00

ΕΚΤΥΠΩΣΗ: ABK PRINT.GR τηλ.: 210 23.89.481-3

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6A9B93E06A2C90321C588D5D9034935A5DB4BC73 1765 00434804 1303122207 EKX12001543>

ΕΛΛΗΝΙΚΑ ΤΑΧΥΔΡΟΜΕΙΑ Α.Ε.
ΥΠΟΚΑΤΑΣΤΗΜΑ: ΝΕΑ ΖΙΧΝΗ
Τ.Κ. ΓΡΑΦΕΙΟΥ: 62042
ΤΗΛΕΦΩΝΟ: 2324022278
Χρήστης: 04758501
Σειρά: 1
Αρ. Παραστατ.: 04758010100067221
ΑΠΕΛΛΟΥ 1, ΑΘΗΝΑ, 10188
Α.Φ.Μ. 094026421 ΜΕΓΑΛΩΝ ΕΠΙΧ/ΣΕΩΝ
ΑΡ.Μ.Α.Ε.: 1429/01/Β/86/1428

ΑΠΟΔΕΙΞΗ ΕΙΣΠΡΑΞΗΣ ΓΙΑ Λ/ΜΟ ΤΡΙΤΩΝ
& ΕΙΣΠΡΑΞΗΣ ΤΕΛΩΝ

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Αρ.Σύμβασης:	1316090
Οργανισμός:	ΠΛΑΙΣΙΟ COMPUTERS ΑΕΒΕ
Ταυτ. πελάτη:	0000004018065832G
Νόμισμα:	EUR
Ποσό:	299,00 Ε
Τέλη:	0,00 Ε
ΦΠΑ τελών:	0,00 Ε
Εισπρακτέο Ποσό:	299,00 Ε
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Άρθρο 22 ΚΦΒΣικα Φ.Π.Α

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ΝΟΗΣΙΣ : 6ο ΧΛΜ. Οδού Θεσ/νικης-Θέρμης, ΤΚ.57001, Τηλ.: 2310 471441
ΑΘΗΝΑ : Πανεπιστημίου 56,ΤΚ.10678, Τηλ.: 210 3845102, 210 3842080
Α.Φ.Μ.: 081956280 Δ.Ο.Υ.: Β' Θεσσαλονίκης
http://www.astronomy.gr email: astronomy@planitario.gr

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ΣΕΙΡΑ/ΑΡΙΘΜΟΣ	ΑΕΠ-ΤΧ-00135	ΗΜΕΡΟΜΗΝΙΑ	13/4/2013	ΑΞΙΑ :	1.701,00 EUR

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ΕΠΩΝΥΜΙΑ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ: ΝΠΔΔ
ΔΙΕΥΘΥΝΣΗ: ΝΕΑ ΖΙΧΝΗ
62042 ΝΕΑ ΖΙΧΝΗ ΣΕΡΡΩΝ
ΤΗΛ : (23240)22204 **ΑΦΜ :** 090384085
FAX: (23240)20029 **ΔΟΥ:** Α Σερρών

ΠΑΡΑΤΗΡΗΣΕΙΣ
ΕΞΟΦΛΗΣΗ ΤΔΑ140/1-4-13

ΤΡΑΠΕΖΑ-ΤΑΜΕΙΟ	ΑΡΙΘΜΟΣ ΕΠΙΤΑΓΗΣ	ΗΜ. ΛΗΞΗΣ	ΠΟΣΟ
Λογαριασμός όψεως ΕΘΝΙΚΗΣ ΤΡΑΠΕΖΑΣ			1.603,19
ΔΗΜΟΣΙΟΥ_4 Κράτηση Δημοσίου Προιόντων 4%			97,81

ΟΛΟΓΡΑΦΩΣ: Χίλια Επτακόσια Ένα Ευρώ **ΣΥΝΟΛΟ:** 1.701,00 EUR

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Πλήρωσε ο

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ΕΙΣΑΓΩΓΕΣ ΕΙΔΩΝ ΑΣΤΡΟΝΟΜΙΑΣ - ΕΚΔΟΣΕΙΣ
Υποκ/μα 3: Αντώνη Τρίτση 15-17, Τ.Κ. 57001, τηλ.: 2310 541 826, 2310 533 902, fax: 2310 550 672, Πυλαία
Έδρα: Πολυτεχνείου 45, τηλ.: 2310 541 603 , Τ.Κ. 54625, ΘΕΣΣΑΛΟΝΙΚΗ
Υποκ/μα 1: Πανεπιστημίου 56, Τ.Κ. 10678, τηλ.: 210 38 45 102, fax: 210 3842030, ΑΘΗΝΑ
Υποκ/μα 2: 6ο χλμ. Οδού Θεσ/νίκης - Θέρμης, εντός του Κ. Δ. Ε. Μ. Τ. "ΝΟΗΣΙΣ", Τ.Κ. 570 01, τηλ.: 2310 471 441, ΘΕΣ/ΝΙΚΗ
Α.Φ.Μ. 081956280 - ΔΟΥ Α΄ ΘΕΣΣΑΛΟΝΙΚΗΣ (Β΄ Α΄ Γ΄ ΘΕΣΣΑΛΟΝΙΚΗΣ)
e-mail: planitario@astronomy.gr

Πλανητάριο
ΘΕΣΣΑΛΟΝΙΚΗΣ

ΠΡΩΤΟΤΥΠΟ

ΕΙΔΟΣ ΠΑΡΑΣΤΑΤΙΚΟΥ	Νο ΠΑΡΑΣΤΑΤΙΚΟΥ	ΗΜΕΡΟΜΗΝΙΑ
Δελτίο Αποστολής - Τιμ.Πώλησης	ΤΔΑ-Τ-00140	1/4/2013

ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ

ΚΩΔΙΚΟΣ: 108434
ΕΠΩΝΥΜΙΑ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ: ΝΠΔΔ
ΔΙΕΥΘ/ΣΗ : ΝΕΑ ΖΙΧΝΗ
ΠΟΛΗ : 62042 ΝΕΑ ΖΙΧΝΗ
ΤΗΛ. : (23240)22204 **FAX:** (23240)20029
Α.Φ.Μ : 090384085 **ΔΟΥ:** Α Σερρών

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ	ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ
ΠΔΣ-ΤΧ-00091 19/3/2013	Πώληση
ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ	ΤΡΟΠΟΣ ΑΠΟΣΤΟΛΗΣ
Επι Πιστώσει	Courier

ΤΟΠΟΣ ΑΠΟΣΤΟΛΗΣ: ΑΝΤ.ΤΡΙΤΣΗ 15-17
ΤΟΠΟΣ ΠΑΡΑΔΟΣΗΣ: ΝΕΑ ΖΙΧΝΗ
62042 ΝΕΑ ΖΙΧΝΗ

ΚΩΔΙΚΟΣ	ΠΕΡΙΓΡΑΦΗ ΕΙΔΟΥΣ	Μ/Μ	ΠΟΣ.	ΤΙΜΗ	ΕΚΠΤΩΣΕΙΣ %	ΕΚΠΤΩΣΕΙΣ ΑΞΙΑ	ΚΑΘ. ΑΞΙΑ	% ΦΠΑ
SKBKP2001	ΤΗΛΕΣΚ."SKYWATCHER 200mm BK"(only tube)	ΤΕΜ	1	312,20	0,00	0,00	312,20	23,00
CE93711	NEXIMAGE 5 SOLAR SYSTEM IMAGER	ΤΕΜ	1	218,68	0,00	0,00	218,68	23,00
TVBLW-2125	BARLOW 2x TeleVue	ΤΕΜ	1	104,88	0,00	0,00	104,88	23,00
BA-2459281	ΦΙΛΤΡΟ ASTROSOLAR SAFETY FILM,20x30cm	ΤΕΜ	1	21,14	0,00	0,00	21,14	23,00
AO7300	ΦΙΛΤΡΟ ΣΕΛΗΝΗΣ	ΤΕΜ	1	10,57	0,00	0,00	10,57	23,00
BA-2458275	ΦΙΛΤΡΟ UHC-S NEBULA 1,1/4"	ΤΕΜ	1	55,28	0,00	0,00	55,28	23,00
916-9045	ΤΡΟΦΟΔΟΤΙΚΟ SWITCHING 12V,2A	ΤΕΜ	1	16,26	0,00	0,00	16,26	23,00
CE93402	T-RING "NIKON"	ΤΕΜ	1	15,47	0,00	0,00	15,47	23,00
BA-2458141	ΑΝΤΑΠΤΟΡΑΣ ΓΙΑ ΠΡΟΒΟΛΗ "OPFA-1"	ΤΕΜ	1	47,15	0,00	0,00	47,15	23,00
CE91518	ΣΤΗΡΙΞΗ ΡΟΜΠΟΤΙΚΗ CG-5	ΤΕΜ	1	581,30	0,00	0,00	581,30	23,00

ΑΡΧΙΚΗ ΑΞΙΑ	ΑΞΙΑ ΕΚΠΤΩΣΗΣ	ΠΡΟΣΘ. ΕΚΠΤ.	ΣΥΝ. ΚΑΘ. ΑΞΙΑΣ	ΦΠΑ	ΣΥΝ. ΑΞΙΑΣ ΕΙΔΩΝ	ΕΞΟΔΑ	Φ.Π.Α. ΕΞΟΔΩΝ	**ΠΛΗΡΩΤΕΟ**
1.382,93	0,00	0,00	1.382,93	318,07	1.701,00	0,00	0,00	1.701,00

ΠΡΟΗΓ. ΥΠΟΛΟΙΠΟ	ΝΕΟ ΥΠΟΛΟΙΠΟ	ΣΥΝ. ΠΟΣΟΤΗΤΑΣ	ΩΡΑ ΕΝΑΡΞΗΣ	ΩΡΑ ΠΑΡΑΔΟΣΗΣ	Ο ΕΚΔΟΤΗΣ	Ο ΠΑΡΑΛΑΒΩΝ
0,00	1.701,00	10	2:32:58μμ			

ΑΝΑΛΥΣΗ Φ.Π.Α. ΚΑΤΑ ΣΥΝΤΕΛΕΣΤΗ

% ΦΠΑ	ΚΑΘΑΡΗ ΑΞΙΑ	ΑΞΙΑ ΦΠΑ	ΣΥΝΟΛ. ΑΞΙΑ
23,00	1.382,93	318,07	1.701,00
0,00	0,00	0,00	0,00
0,00	0,00	0,00	0,00

ΠΑΡΑΤΗΡΗΣΕΙΣ *Τα εμπορεύματα ταξιδεύουν για λογαριασμό και με την ευθύνη του αγοραστή

- ΣΑΣ ΕΝΗΜΕΡΩΝΟΥΜΕ ΟΤΙ ΒΑΣΕΙ ΤΟΥ ΝΟΜΟΥ Ν. 2472/97 ΤΗΡΟΥΜΕ ΤΑ ΠΡΟΣΩΠΙΚΑ ΣΤΟΙΧΕΙΑ ΣΑΣ ΣΤΟ ΑΡΧΕΙΟ ΜΑΣ ΚΑΙ ΕΧΕΤΕ ΠΡΟΣΒΑΣΗ ΣΕ ΑΥΤΑ ΣΥΜΦΩΝΑ ΜΕ ΤΟ ΝΟΜΟ.
- ΓΙΑ ΚΑΘΕ ΔΙΑΦΟΡΑ ΑΠΟ ΤΗΝ ΠΑΡΟΥΣΑ ΣΥΝΑΛΛΑΓΗ, ΣΥΜΦΩΝΕΙΤΑΙ ΡΗΤΩΣ ΟΤΙ ΑΡΜΟΔΙΑ ΕΙΝΑΙ ΤΑ ΔΙΚΑΣΤΗΡΙΑ ΘΕΣΣΑΛΟΝΙΚΗΣ.

2CD03EAC902E52E55BA9C7DE51CE901EDE3223C5 0005 00004234 1304011439 EPX10019335

Επίσημος Αντιπρόσωπος

CELESTRON Sky-Watcher TeleVue Vixen baader planetarium Kowa TAKAHASHI OFFICINASTELLARE

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ΕΙΔΗ ΑΣΤΡΟΝΟΜΙΑΣ - ΕΚΔΟΣΕΙΣ

ΘΕΣΣΑΛΟΝΙΚΗ : Πολυτεχνείου 45,4ος (Λαδάδικα), ΤΚ.54625, Τηλ.: 2310 533902, 2310 541826 Fax: 2310 550672
ΝΟΗΣΙΣ : 6ο ΧΛΜ. Οδού Θεσ/νικης-Θέρμης, ΤΚ.57001, Τηλ.: 2310 471441
ΑΘΗΝΑ : Πανεπιστημίου 56,ΤΚ.10678, Τηλ.: 210 3845102, 210 3842080
Α.Φ.Μ.: 081956280 Δ.Ο.Υ.: Β' Θεσσαλονίκης
http://www.astronomy.gr **email: astronomy@planitario.gr**

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ΣΕΙΡΑ/ΑΡΙΘΜΟΣ	ΑΕΠ-ΤΧ-00136	**ΗΜΕΡΟΜΗΝΙΑ**	13/4/2013	**ΑΞΙΑ :**	139,00 EUR

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ΕΠΩΝΥΜΙΑ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ: ΝΠΔΔ
ΔΙΕΥΘΥΝΣΗ: ΝΕΑ ΖΙΧΝΗ
62042 ΝΕΑ ΖΙΧΝΗ ΣΕΡΡΩΝ
ΤΗΛ : (23240)22204 **ΑΦΜ :** 090384085
FAX: (23240)20029 **ΔΟΥ:** Α Σερρών

ΠΑΡΑΤΗΡΗΣΕΙΣ
ΕΞΟΦΛΗΣΗ ΤΔΑ141/1-4-13

ΤΡΑΠΕΖΑ-ΤΑΜΕΙΟ	**ΑΡΙΘΜΟΣ ΕΠΙΤΑΓΗΣ**	**ΗΜ. ΛΗΞΗΣ**	**ΠΟΣΟ**
Λογαριασμός όψεως ΕΘΝΙΚΗΣ ΤΡΑΠΕΖΑΣ			135,53
ΔΗΜΟΣΙΟΥ_4	Κράτηση Δημοσίου Προιόντων 4%		3,47

ΟΛΟΓΡΑΦΩΣ: Εκατό Τριάντα Εννιά Ευρώ

ΣΥΝΟΛΟ: 139,00 EUR

Εισεπραξε ο

Πλήρωσε ο

Μ. ΤΣΑΜΠΟΥΡΑΣ & ΣΙΑ Ο.Ε.
ΑΓΩΓΕΣ ΕΙΔΩΝ ΑΣΤΡΟΝΟΜΙΑΣ - ΕΚΔΟΣΕΙΣ
οκ/μα 3: Αντώνη Τρίτση 15-17, Τ.Κ. 57001, τηλ.: 2310 541 826, 2310 533 902, fax: 2310 550 672, Πυλαία
δρα: Πολυτεχνείου 45, τηλ.: 2310 541 603 , Τ.Κ. 54625, ΘΕΣΣΑΛΟΝΙΚΗ
οκ/μα 1: Πανεπιστημίου 56, Τ.Κ. 10678, τηλ.: 210 38 45 102, fax: 210 3842030, ΑΘΗΝΑ
οκ/μα 2: 6ο χλμ. Οδού Θεσ/νίκης - Θέρμης, εντός του Κ. Δ. Ε. Μ. Τ. "ΝΟΗΣΙΣ", Τ.Κ. 570 01, τηλ.: 2310 471 441, ΘΕΣ/ΝΙΚΗ
Α.Φ.Μ. 081956280 - ΔΟΥ Α΄ ΘΕΣΣΑΛΟΝΙΚΗΣ (Β΄ Α΄ Γ΄ ΘΕΣΣΑΛΟΝΙΚΗΣ)
e-mail: planitario@astronomy.gr

Πλανητάριο
ΘΕΣΣΑΛΟΝΙΚΗΣ

ΠΡΩΤΟΤΥΠΟ

ΕΙΔΟΣ ΠΑΡΑΣΤΑΤΙΚΟΥ	No ΠΑΡΑΣΤΑΤΙΚΟΥ	ΗΜΕΡΟΜΗΝΙΑ
Δελτίο Αποστολής - Τιμ.Πώλησης	ΤΔΑ-Τ-00141	1/4/2013

ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ

ΚΩΔΙΚΟΣ: 108434
ΕΠΩΝΥΜΙΑ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ: ΝΠΔΔ
ΔΙΕΥΘ/ΣΗ : ΝΕΑ ΖΙΧΝΗ
ΠΟΛΗ : 62042 ΝΕΑ ΖΙΧΝΗ
ΤΗΛ. : (23240)22204 **FAX:** (23240)20029
Α.Φ.Μ : 090384085 **ΔΟΥ:** Α Σερρών

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ	ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ
ΠΔΣ-ΤΧ-00104 29/3/2013	Πώληση
ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ	ΤΡΟΠΟΣ ΑΠΟΣΤΟΛΗΣ
Επι Πιστώσει	Courier

ΤΟΠΟΣ ΑΠΟΣΤΟΛΗΣ: ΑΝΤ.ΤΡΙΤΣΗ 15-17
ΤΟΠΟΣ ΠΑΡΑΔΟΣΗΣ: ΝΕΑ ΖΙΧΝΗ
62042 ΝΕΑ ΖΙΧΝΗ

ΚΩΔΙΚΟΣ	ΠΕΡΙΓΡΑΦΗ ΕΙΔΟΥΣ	Μ/Μ	ΠΟΣ.	ΤΙΜΗ	ΕΚΠΤΩΣΕΙΣ %	ΕΚΠΤΩΣΕΙΣ ΑΞΙΑ	ΚΑΘ. ΑΞΙΑ	% ΦΠΑ
CE71009	ΚΙΑΛΙΑ "SKYMASTER" 15x70-BIG BINO	ΤΕΜ	1	129,00	23,26	24,39	80,49	23,00

ΑΡΧΙΚΗ ΑΞΙΑ	ΑΞΙΑ ΕΚΠΤΩΣΗΣ	ΠΡΟΣΘ. ΕΚΠΤ.	ΣΥΝ. ΚΑΘ. ΑΞΙΑΣ	ΦΠΑ	ΣΥΝ. ΑΞΙΑΣ ΕΙΔΩΝ	ΕΞΟΔΑ	Φ.Π.Α. ΕΞΟΔΩΝ	**ΠΛΗΡΩΤΕΟ**
104,88	24,39	0,00	80,49	18,51	99,00	32,52	7,48	139,00

ΠΡΟΗΓ. ΥΠΟΛΟΙΠΟ	ΝΕΟ ΥΠΟΛΟΙΠΟ	ΣΥΝ. ΠΟΣΟΤΗΤΑΣ	ΩΡΑ ΕΝΑΡΞΗΣ	ΩΡΑ ΠΑΡΑΔΟΣΗΣ	Ο ΕΚΔΟΤΗΣ	Ο ΠΑΡΑΛΑΒΩΝ
1.701,00	1.840,00	1	4:38:27μμ			

ΑΝΑΛΥΣΗ Φ.Π.Α. ΚΑΤΑ ΣΥΝΤΕΛΕΣΤΗ

% ΦΠΑ	ΚΑΘΑΡΗ ΑΞΙΑ	ΑΞΙΑ ΦΠΑ	ΣΥΝΟΛ. ΑΞΙΑ
23,00	113,01	25,99	139,00
0,00	0,00	0,00	0,00
0,00	0,00	0,00	0,00

ΠΑΡΑΤΗΡΗΣΕΙΣ *Τα εμπορεύματα ταξιδεύουν για λογαριασμό και με την ευθύνη του αγοραστή

- ΣΑΣ ΕΝΗΜΕΡΩΝΟΥΜΕ ΟΤΙ ΒΑΣΕΙ ΤΟΥ ΝΟΜΟΥ Ν. 2472/97 ΤΗΡΟΥΜΕ ΤΑ ΠΡΟΣΩΠΙΚΑ ΣΤΟΙΧΕΙΑ ΣΑΣ ΣΤΟ ΑΡΧΕΙΟ ΜΑΣ ΚΑΙ ΕΧΕΤΕ ΠΡΟΣΒΑΣΗ ΣΕ ΑΥΤΑ ΣΥΜΦΩΝΑ ΜΕ ΤΟ ΝΟΜΟ.
- ΓΙΑ ΚΑΘΕ ΔΙΑΦΟΡΑ ΑΠΟ ΤΗΝ ΠΑΡΟΥΣΑ ΣΥΝΑΛΛΑΓΗ, ΣΥΜΦΩΝΕΙΤΑΙ ΡΗΤΩΣ ΟΤΙ ΑΡΜΟΔΙΑ ΕΙΝΑΙ ΤΑ ΔΙΚΑΣΤΗΡΙΑ ΘΕΣΣΑΛΟΝΙΚΗΣ.

F44B0B353F30C9EE317BC38C4542C42D6400E24A 0015 00004244 1304011644 EPX10019335

Επίσημος Αντιπρόσωπος

CELESTRON Sky-Watcher TeleVue Visionary Vixen baader planetarium Kowa TAKAHASHI OFFICINASTELLARE

www.skd.gr - info@skd.gr
Μέλος του ομίλου ΠΡΟΜΗΛ Α.Ε.

ΣΙΔΗΡΟΠΟΥΛΟΣ ΚΩΝ. ΔΗΜΗΤΡΙΟΣ
ΗΛΕΚΤΡΟΛΟΓΙΚΟ ΥΛΙΚΟ - ΦΩΤΙΣΜΟΣ
ΑΦΜ: 016287511 - ΔΟΥ: Ζ' ΘΕΣ/ΝΙΚΗΣ
ΚΕΝΤΡΙΚΟ: 6ο ΧΛΜ ΧΑΡΙΛΑΟΥ - ΘΕΡΜΗΣ, ΘΕΣ/ΝΙΚΗ
Τ. 2310 472201, 2310 472121, 2310 319932 - F. 2310 472162
ΥΠΟΚ/ΜΑ 1: ΚΩΝ. ΚΑΡΑΜΑΝΛΗ 155, ΘΕΣ/ΝΙΚΗ Τ. 2310 321143 - F. 2310 323590
ΥΠΟΚ/ΜΑ 2: ΚΩΝ. ΚΑΡΑΜΑΝΛΗ 157, ΘΕΣ/ΝΙΚΗ Τ. 2310 305916 - F. 2310 323590

ΕΙΔΟΣ ΠΑΡΑΣΤΑΤΙΚΟΥ	ΣΕΙΡΑ	ΑΡΙΘΜΟΣ	ΗΜΕΡΟΜΗΝΙΑ
ΔΑ ΤΙΜΟΛΟΓΙΟ ΠΩΛΗΣΗΣ		002667	08/07/2013 13:01:00

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ

ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ

ΚΩΔΙΚΟΣ	5-0353
ΕΠΩΝΥΜΙΑ	ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΔΙΕΥΘΥΝΣΗ	Ν.ΖΙΧΝΗ
ΠΟΛΗ	ΝΕΑ ΖΙΧΝΗ
ΕΠΑΓΓΕΛΜΑ	Ν.Π.Δ.Δ.
Α.Φ.Μ.	090384085
Δ.Ο.Υ.	Α΄ ΣΕΡΡΩΝ Τ Η Λ 23240/22204

ΣΤΟΙΧΕΙΑ ΠΑΡΑΛΗΠΤΗ

ΕΠΩΝΥΜΙΑ	
ΕΠΑΓΓΕΛΜΑ	
ΑΦΜ	
ΔΟΥ	
ΟΔΟΣ /ΑΡΙΘ	
ΠΟΛΗ /ΤΚ	
ΤΗΛ.	

ΤΟΠΟΣ ΠΡΟΟΡΙΣΜΟΥ ΕΔΡΑ ΠΕΛΑΤΗ ΣΚΟΠΟΣ ΔΙΑΚΙΝ ΠΩΛΗΣΗ ΑΡΙΘ. ΑΥΤΟΚ

ΤΟΠΟΣ ΦΟΡΤΩΣΗΣ ΑΠΟΘΗΚΗ ΥΠΟΚΑΤΑΣΤ ΕΚΠΤΩΣΗ ΠΕΛΑΤΗ 0 % ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ ΜΕΤΡΗΤΟΙΣ

ΚΩΔΙΚΟΣ	ΠΕΡΙΓΡΑΦΗ	ΜΟΝ	ΠΟΣ	ΤΙΜΗ	ΑΞΙΑ	ΑΞΙΑ Εκ	Καθ.Αξία	ΦΠΑ%
043.0302	ΚΑΡΟΥΛΙ ΜΕΤΑΛ. ΜΙΚΡΟ ΚΑΛΩΔΙΟ 3*1,5 50Μ	ΤΕΜ	1,00	36,50000	36,50	0,000	36,50	23

ΠΑΡΑΤΗΡΗΣΕΙΣ

ΣΥΝΟΛΟ ΑΞΙΑ	36,50
ΣΥΝΟΛΟ ΕΚΠΤΩΣΗΣ	0,00
ΣΥΝΟΛΟ ΚΑΘΑΡΟ	36,50
ΣΥΝΟΛΟ ΦΠΑ	8,40
ΓΕΝΙΚΟ ΣΥΝΟΛΟ	44,90
ΚΡΑΤΗΣΕΙΣ	0
ΕΠΙΒΑΡΥΝΣΕΙΣ	0,00
ΦΠΑ ΕΠΙΒΑΡΥΝΣΕΙΣ	0,00
ΤΕΛΙΚΗ ΑΞΙΑ	**44,90**

GIA PELATH

	0,00
	0,00

ΑΝΑΛΥΣΗ Φ.Π.Α.

ΑΞΙΑ	ΠΟΣΟΣΤΟ	ΠΟΣΟ ΦΠΑ
36,50	23,00	8,40

ΥΠΟΚ. Κ. ΚΑΡΑΜΑΝΛΗ 157 ΕΚΔΟΣΗ ΠΑΡΑΛΑΒΗ

*ΑΛΛΑΓΕΣ ΛΙΑΝΙΚΗΣ ΠΩΛΗΣΗΣ ΔΕ ΓΙΝΟΝΤΑΙ ΧΩΡΙΣ ΑΠΟΔΕΙΞΗ
*ΤΑ ΕΜΠΟΡΕΥΜΑΤΑ ΤΑΞΙΔΕΥΟΥΝ ΓΙΑ ΛΟΓΑΡΙΑΣΜΟ ΚΑΙ ΜΕ ΚΙΝΔΥΝΟ ΤΟΥ ΠΕΛΑΤΗ
*ΓΙΑ ΚΑΘΕ ΔΙΑΦΟΡΑ ΑΡΜΟΔΙΑ ΕΙΝΑΙ ΤΑ ΔΙΚΑΣΤΗΡΙΑ ΘΕΣΣΑΛΟΝΙΚΗΣ

CE0F87E4CB14154A1030804FF6B50FE033232903 0033 00018782 1307081250 EHO110001042

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Υποστήριξη, Εμπόριο Η/Υ προγραμμάτων
Υπηρεσίες Internet και τηλεπικοινωνίες
Προμηθέως 3 Τ.Κ. 54627 Θεσσαλονίκη
Τηλ. : 2310502695 φαξ : 2310514547
Α.Φ.Μ. : 079290555 Δ.Ο.Υ. : Ά Θεσσαλονίκης
www.netchoice.gr, email : info@netchoice.gr
sales@netchoice.gr, support@netchoice.gr

Στοιχεία Παραστατικού

ΠΡΩΤΟΤΥΠΟ

Δ.Αποστολής Τιμολόγιο **ΔΑΤ 787 ΗΜΕΡ/ΝΙΑ 08/07/2013 ΩΡΑ 17:16**

Στοιχεία Αντισυμβαλλομένου

ΚΩΔΙΚΟΣ : 1027
ΕΠΩΝΥΜΙΑ : ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ : Ν.Π.Δ.Δ
ΟΔΟΣ/ΑΡΙΘ. : Νέα Ζύχνι
ΠΟΛΗ : Νέα Ζύχνι **Τ.Κ.** 60042
ΤΗΛΕΦΩΝΟ : 2324022204
Α.Φ.Μ. : 090384085
Δ.Ο.Υ. : Α ΣΕΡΡΩΝ

Στοιχεία διακίνησης και αποστολής

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ :
ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ : Προς Πώληση
ΤΟΠΟΣ ΦΟΡΤΩΣΗΣ : ΕΔΡΑ ΜΑΣ
ΤΟΠΟΣ ΠΡΟΟΡΙΣΜΟΥ : Νέα Ζύχνι
Νέα Ζύχνι
ΤΡΟΠΟΣ ΑΠΟΣΤΟΛΗΣ : Παραλαβή απο Πελάτη
ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ : Τοίς Μετρητοίς
ΕΚΠΤΩΣΗ ΠΕΛΑΤΗ : 0,00

Στοιχεία προιόντων υπηρεσιών

Κωδικός	Περιγραφή	Μ.Μ	Ποσότητα	Τιμή	Αξία Προ Έκπτωσης	Έκπτωση %	Έκπτωση Ποσό	Αξία Μετά Έκπτωσης	ΦΠΑ %
006486	PATCH CORD UTP CAT.5 5M BLUE	Τεμ.	5	2,00	10,00	0,00	0,00	10,00	23,
006485	FLASH MICROSD PNY 8GB ADAPTER HC	Τεμ.	1	6,20	6,20	0,00	0,00	6,20	23,

Προηγ. Υπόλοιπο	0,00	Σύν. ποσότητας	6
Νέο Υπόλοιπο	0,00	Αιτιολογία	

Ανάλυση Φ.Π.Α.

16,20	ΦΠΑ 23%	3,73

Ανάλυση αξιών παραστατικού

ΑΞΙΑ ΠΡΟ ΕΚΠΤΩΣΗΣ	16,20
ΕΚΠΤΩΣΗ	0,00
ΑΞΙΑ ΜΕΤΑ ΤΗΝ ΕΚΠΤΩΣΗ	16,20
Φ.Π.Α.	3,73
ΤΕΛΙΚΗ ΑΞΙΑ	19,93

Παρατηρήσεις

Έκδοση Παραλαβή

EC50F10217C1AB4AEB25CD96C955DDE8CF8F7ABC 0003 00006641 1307081734 EMZ07020535

ΑΠΟΔΕΙΞΗ ΠΑΡΟΧΗΣ ΥΠΗΡΕΣΙΩΝ

№ 5655

HOTEL "LEON"
ΟΛΓΑ ΧΑΝΟΖΙΔΟΥ & ΣΙΑ Ε.Ε.

640 08 ΠΑΡΑΛΙΑ ΟΦΡΥΝΙΟΥ - ΚΑΒΑΛΑ
GR 640 08 OFRINIO BEACH, KAVALA-HELLAS
ΤΗΛ. 0594/31347 FAX 0594/31227
Α.Φ.Μ. 093602990

Δωμάτιο 207

Ονοματεπώνυμο
ΓΕΝΙΚΟ ΛΥΚΕΙΟ
ΝΕΑΣ ΣΙΧΝΗΣ

Α.Φ.Μ. 090384085

Δ.Ο.Υ. Δ' ΣΕΡΡΩΝ

2324022204 ΤΗΛ.

ΔΙΚΑΙΟΛΟΓΗΤΙΚΑ ΧΡΕΩΣΕΩΝ

ΠΤΙ

Ολικό ποσό δρχ.

Δρχ.

Ημερ/νία Άφιξης

Ημερ/νία Αναχ.

Ημερ/νία καταχώρησης στο Ταμείο

Τούζλα

ΥΠΟΓΡΑΦΗ ΥΠΑΛΛΗΛΟΥ

ΜΗΝ	ΙΟΥΝΙΟΣ	ΔΩΜ.	7	ΑΤΟΜΑ	2
C/O		ROM V/No		PERSONS	

ΜΗΝ / MONTH							
Ενοίκιο - Room	30€						
Πρωινό - Breakfast ως Α.Π.Υ.							
Μπάρ - Bar ως Α.Π.Υ.							
Τηλέφωνο - Phone ως Α.Π.Υ.							
Εστιατόριο-Restaurant ως Α.Π.Υ.							
Διάφορα - Various ως Α.Π.Υ.							
Σύνολο ημέρας Total Day							

Προσαύξηση 20% 3ης κλίνης Third bed 20% increase	
Προσαύξηση 10% για παραμονή 1-2 ημέρες 1-2 Days stay 10% increase	

ΣΤΙΣ ΑΝΩΤΕΡΩ ΤΙΜΕΣ ΣΥΜΠΕΡΙΛΑΜΒΑΝΟΝΤΑΙ
Φ.Π.Α. & ΔΗΜΟΤΙΚΟΣ ΦΟΡΟΣ

Σύνολο - Total 30€

ΟΙ ΕΒΔΟΜΑΔΙΑΙΟΙ ΛΟΓΑΡΙΑΣΜΟΙ ΕΞΟΦΛΟΥΝΤΑΙ ΜΕ ΤΗΝ ΕΚΔΟΣΗ ΤΟΥΣ

Πληρωτέο ποσό 30€

Παρ. Οφρυνίου
Ofrinio Beach 17/07/13

ΣΑΣ ΕΥΧΑΡΙΣΤΟΥΜΕ - ΚΑΛΟ ΤΑΞΙΔΙ
WE THANK YOU, WISING YOU "BON VOYAGE"

ΛΕΥΚΟ: ΠΕΛΑΤΗΣ - ΡΟΖ: ΛΟΓΙΣΤΗΡΙΟ - ΚΙΤΡΙΝΟ: ΣΤΕΛΕΧΟΣ

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Χατζηκαλλία Καμ. Δήμητρα
Υποστήριξη, Εμπόριο Η/Υ προγραμμάτων
Υπηρεσίες Internet και τηλεπικοινωνίες
Προμηθέως 3 Τ.Κ. 54627 Θεσσαλονίκη
Τηλ. : 2310502695 φαξ : 2310514547
Α.Φ.Μ. : 079290555 Δ.Ο.Υ. : Ά Θεσσαλονίκης
www.netchoice.gr, email : info@netchoice.gr
sales@netchoice.gr, support@netchoice.gr

Στοιχεία Παραστατικού

ΠΡΩΤΟΤΥΠΟ

Δ.Αποστολής Τιμολόγιο **ΔΑΤ 810** **ΗΜΕΡ/ΝΙΑ 27/08/2013** **ΩΡΑ 16:03**

Στοιχεία Αντισυμβαλλομένου

ΚΩΔΙΚΟΣ : 1027
ΕΠΩΝΥΜΙΑ : ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ

ΕΠΑΓΓΕΛΜΑ : Ν.Π.Δ.Δ
ΟΔΟΣ/ΑΡΙΘ. : Νέα Ζύχνι
ΠΟΛΗ : Νέα Ζύχνι **Τ.Κ.** 60042
ΤΗΛΕΦΩΝΟ : 2324022204
Α.Φ.Μ. : 090384085
Δ.Ο.Υ. : Α ΣΕΡΡΩΝ

Στοιχεία διακίνησης και αποστολής

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ : ΠΑΡΧ001504

ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ : Προς Πώληση
ΤΟΠΟΣ ΦΟΡΤΩΣΗΣ : ΕΔΡΑ ΜΑΣ
ΤΟΠΟΣ ΠΡΟΟΡΙΣΜΟΥ : Νέα Ζύχνι

Νέα Ζύχνι
ΤΡΟΠΟΣ ΑΠΟΣΤΟΛΗΣ : Παραλαβή απο Πελάτη
ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ : Τοίς Μετρητοίς
ΕΚΠΤΩΣΗ ΠΕΛΑΤΗ : 3,21

Στοιχεία προϊόντων υπηρεσιών

Κωδικός	Περιγραφή	Μ.Μ	Ποσότητα	Τιμή	Αξία Προ Έκπτωσης	Έκπτωση %	Έκπτωση Ποσό	Αξία Μετά Έκπτωσης	ΦΠΑ %
003644	SWITCH D-LINK 8X10/100/1G DES-1008D	Τεμ.	1	14,00	14,00	0,00	0,00	14,00	23,
006408	ΠΟΛΥΜΠΡΙΖΟ SAS 5ΘΕΣΕΩΝ ΜΕ ΔΙΑΚΟΠΤΗ 1.5Μ ΚΑΛΩΔΙΟ	Τεμ.	2	4,50	9,00	0,00	0,00	9,00	23,
006372	ΚΑΛΩΔΙΟ ΠΡΟΕΚΤΑΣΗ USB A M/F 1.8M	Τεμ.	2	0,95	1,90	0,00	0,00	1,90	23,
001018	ΚΑΛΩΔΙΟ "NEXANS" UTP Level5e 4x2xAWG24	Μέτρ	30	0,57	17,10	0,00	0,00	17,10	23,

Προηγ. Υπόλοιπο 0,00
Νέο Υπόλοιπο 0,00

Σύν. ποσότητας 35

Αιτιολογία

Ανάλυση Φ.Π.Α.

40,65	ΦΠΑ 23%	9,35

Ανάλυση αξιών παραστατικού

ΑΞΙΑ ΠΡΟ ΕΚΠΤΩΣΗΣ	42,00
ΕΚΠΤΩΣΗ	1,35
ΑΞΙΑ ΜΕΤΑ ΤΗΝ ΕΚΠΤΩΣΗ	40,65
Φ.Π.Α.	9,35
ΤΕΛΙΚΗ ΑΞΙΑ	50,00

Παρατηρήσεις

Έκδοση Παραλαβή

740606B20F28F7EF647AE2792362230D6A0279F7 0001 00006749 1308271622 EMZ07020535

ΔΗΜ. ΤΣΑΜΠΟΥΡΑΣ & ΣΙΑ Ο.Ε.
ΕΙΣΑΓΩΓΕΣ ΕΙΔΩΝ ΑΣΤΡΟΝΟΜΙΑΣ - ΕΚΔΟΣΕΙΣ
Υποκ/μα 3: Αντώνη Τρίτση 15-17, Τ.Κ. 57001, τηλ.: 2310 541 826, 2310 533 902, fax: 2310 550 672, Πυλαία
Έδρα: Πολυτεχνείου 45, τηλ.: 2310 541 603 , Τ.Κ. 54625, ΘΕΣΣΑΛΟΝΙΚΗ
Υποκ/μα 1: Πανεπιστημίου 56, Τ.Κ. 10678, τηλ.: 210 38 45 102, fax: 210 3842030, ΑΘΗΝΑ
Υποκ/μα 2: 6ο χλμ. Οδού Θεσ/νίκης - Θέρμης, εντός του Κ. Δ. Ε. Μ. Τ. "ΝΟΗΣΙΣ", Τ.Κ. 570 01, τηλ.: 2310 471 441, ΘΕΣ/ΝΙΚΗ
Α.Φ.Μ. 081956280 - ΔΟΥ Α΄ ΘΕΣΣΑΛΟΝΙΚΗΣ (Β΄ Α΄ Γ΄ ΘΕΣΣΑΛΟΝΙΚΗΣ)
e-mail: planitario@astronomy.gr

Πλανητάριο
ΘΕΣΣΑΛΟΝΙΚΗΣ

ΠΡΩΤΟΤΥΠΟ

ΕΙΔΟΣ ΠΑΡΑΣΤΑΤΙΚΟΥ	Νο ΠΑΡΑΣΤΑΤΙΚΟΥ	ΗΜΕΡΟΜΗΝΙΑ
Δελτίο Αποστολής - Τιμ.Πώλησης	ΤΔΑ-Τ-00312	30/8/2013

ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ

ΚΩΔΙΚΟΣ: 108434
ΕΠΩΝΥΜΙΑ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ: ΝΠΔΔ
ΔΙΕΥΘ/ΣΗ : ΝΕΑ ΖΙΧΝΗ
ΠΟΛΗ : 62042 ΝΕΑ ΖΙΧΝΗ
ΤΗΛ. : (23240)22204 **FAX:** (23240)20029
Α.Φ.Μ : 090384085 **ΔΟΥ:** Α Σερρών

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ

ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ	ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ / ΤΡΟΠΟΣ ΑΠΟΣΤΟΛΗΣ
Μετρητοίς	Πώληση / Παραλαβή από Πελάτη

ΤΟΠΟΣ ΑΠΟΣΤΟΛΗΣ: ΑΝΤ.ΤΡΙΤΣΗ 15-17
ΤΟΠΟΣ ΠΑΡΑΔΟΣΗΣ: ΝΕΑ ΖΙΧΝΗ
62042 ΝΕΑ ΖΙΧΝΗ

ΚΩΔΙΚΟΣ	ΠΕΡΙΓΡΑΦΗ ΕΙΔΟΥΣ	Μ/Μ	ΠΟΣ.	ΤΙΜΗ	ΕΚΠΤΩΣΕΙΣ %	ΕΚΠΤΩΣΕΙΣ ΑΞΙΑ	ΚΑΘ. ΑΞΙΑ	% ΦΠΑ
AO7610	ΕΡΕΥΝΗΤΗΣ 9x50 ΜΕ ΔΙΑΓΩΝΙΟ 90ο ΚΑΙ ΒΑΣΗ	ΤΕΜ	1	64,23	7,63	4,90	59,33	23,00
BA-1508154	EXTENSION TUBE "T-2",15mm	ΤΕΜ	1	13,01	7,61	0,99	12,02	23,00
BA-1508035	ΑΝΤΑΠΤΟΡΑΣ 2"/T2	ΤΕΜ	1	29,27	7,65	2,24	27,03	23,00

ΑΡΧΙΚΗ ΑΞΙΑ	ΑΞΙΑ ΕΚΠΤΩΣΗΣ	ΠΡΟΣΘ. ΕΚΠΤ.	ΣΥΝ. ΚΑΘ. ΑΞΙΑΣ	ΦΠΑ	ΣΥΝ. ΑΞΙΑΣ ΕΙΔΩΝ	ΕΞΟΔΑ	Φ.Π.Α. ΕΞΟΔΩΝ	**ΠΛΗΡΩΤΕΟ**
106,51	8,13	0,00	98,38	22,62	121,00	0,00	0,00	121,00

ΠΡΟΗΓ. ΥΠΟΛΟΙΠΟ	ΝΕΟ ΥΠΟΛΟΙΠΟ	ΣΥΝ. ΠΟΣΟΤΗΤΑΣ	ΩΡΑ ΕΝΑΡΞΗΣ	ΩΡΑ ΠΑΡΑΔΟΣΗΣ	Ο ΕΚΔΟΤΗΣ	Ο ΠΑΡΑΛΑΒΩΝ
0,00	0,00	3	1:00:42μμ			

ΑΝΑΛΥΣΗ Φ.Π.Α. ΚΑΤΑ ΣΥΝΤΕΛΕΣΤΗ

% ΦΠΑ	ΚΑΘΑΡΗ ΑΞΙΑ	ΑΞΙΑ ΦΠΑ	ΣΥΝΟΛ. ΑΞΙΑ
23,00	98,38	22,62	121,00
0,00	0,00	0,00	0,00
0,00	0,00	0,00	0,00

ΠΑΡΑΤΗΡΗΣΕΙΣ *Τα εμπορεύματα ταξιδεύουν για λογαριασμό και με την ευθύνη του αγοραστή

- ΣΑΣ ΕΝΗΜΕΡΩΝΟΥΜΕ ΟΤΙ ΒΑΣΕΙ ΤΟΥ ΝΟΜΟΥ Ν. 2472/97 ΤΗΡΟΥΜΕ ΤΑ ΠΡΟΣΩΠΙΚΑ ΣΤΟΙΧΕΙΑ ΣΑΣ ΣΤΟ ΑΡΧΕΙΟ ΜΑΣ ΚΑΙ ΕΧΕΤΕ ΠΡΟΣΒΑΣΗ ΣΕ ΑΥΤΑ ΣΥΜΦΩΝΑ ΜΕ ΤΟ ΝΟΜΟ.
- ΓΙΑ ΚΑΘΕ ΔΙΑΦΟΡΑ ΑΠΟ ΤΗΝ ΠΑΡΟΥΣΑ ΣΥΝΑΛΛΑΓΗ, ΣΥΜΦΩΝΕΙΤΑΙ ΡΗΤΩΣ ΟΤΙ ΑΡΜΟΔΙΑ ΕΙΝΑΙ ΤΑ ΔΙΚΑΣΤΗΡΙΑ ΘΕΣΣΑΛΟΝΙΚΗΣ.

EE6BDFDFDA27B697DCFC675F46636E453B8E0F82 0009 00006823 1308301308 EPX10019335

Επίσημος Αντιπρόσωπος

CELESTRON Sky-Watcher TeleVue Vixen baader planetarium Kowa TAKAHASHI OFFICINA STELLARE ZEISS

ΔΗΜ. ΤΣΑΜΠΟΥΡΑΣ & ΣΙΑ Ο.Ε.
ΕΙΣΑΓΩΓΕΣ ΕΙΔΩΝ ΑΣΤΡΟΝΟΜΙΑΣ - ΕΚΔΟΣΕΙΣ
Υποκ/μα 3: Αντώνη Τρίτση 15-17, Τ.Κ. 57001, τηλ.: 2310 541 826, 2310 533 902, fax: 2310 550 672, Πυλαία
Έδρα: Πολυτεχνείου 45, τηλ.: 2310 541 603 , Τ.Κ. 54625, ΘΕΣΣΑΛΟΝΙΚΗ
Υποκ/μα 1: Πανεπιστημίου 56, Τ.Κ. 10678, τηλ.: 210 38 45 102, fax: 210 3842030, ΑΘΗΝΑ
Υποκ/μα 2: 6ο χλμ. Οδού Θεσ/νίκης - Θέρμης, εντός του Κ. Δ. Ε. Μ. Τ. "ΝΟΗΣΙΣ", Τ.Κ. 570 01, τηλ.: 2310 471 441, ΘΕΣ/ΝΙΚΗ
Α.Φ.Μ. 081956280 - ΔΟΥ Α΄ ΘΕΣΣΑΛΟΝΙΚΗΣ (Β΄ Α΄ Γ΄ ΘΕΣΣΑΛΟΝΙΚΗΣ)
e-mail: planitario@astronomy.gr

Πλανητάριο
ΘΕΣΣΑΛΟΝΙΚΗΣ

ΠΡΩΤΟΤΥΠΟ

ΕΙΔΟΣ ΠΑΡΑΣΤΑΤΙΚΟΥ	Νο ΠΑΡΑΣΤΑΤΙΚΟΥ	ΗΜΕΡΟΜΗΝΙΑ
Δελτίο Αποστολής - Τιμ.Πώλησης	ΤΔΑ-Τ-00313	30/8/2013

ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ

ΚΩΔΙΚΟΣ: 108434
ΕΠΩΝΥΜΙΑ: ΓΕΝΙΚΟ ΛΥΚΕΙΟ ΝΕΑΣ ΖΙΧΝΗΣ
ΕΠΑΓΓΕΛΜΑ: ΝΠΔΔ
ΔΙΕΥΘ/ΣΗ : ΝΕΑ ΖΙΧΝΗ
ΠΟΛΗ : 62042 ΝΕΑ ΖΙΧΝΗ
ΤΗΛ. : (23240)22204 **FAX:** (23240)20029
Α.Φ.Μ : 090384085 **ΔΟΥ:** Α Σερρών

ΣΧΕΤΙΚΑ ΠΑΡΑΣΤΑΤΙΚΑ

ΤΡΟΠΟΣ ΠΛΗΡΩΜΗΣ	ΤΡΟΠΟΣ ΑΠΟΣΤΟΛΗΣ
Μετρητοίς	Παραλαβή από Πελάτη

ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ

Πώληση

ΤΟΠΟΣ ΑΠΟΣΤΟΛΗΣ: ΑΝΤ.ΤΡΙΤΣΗ 15-17
ΤΟΠΟΣ ΠΑΡΑΔΟΣΗΣ: ΝΕΑ ΖΙΧΝΗ
62042 ΝΕΑ ΖΙΧΝΗ

ΚΩΔΙΚΟΣ	ΠΕΡΙΓΡΑΦΗ ΕΙΔΟΥΣ	Μ/Μ	ΠΟΣ.	ΤΙΜΗ	ΕΚΠΤΩΣΕΙΣ %	ΕΚΠΤΩΣΕΙΣ ΑΞΙΑ	ΚΑΘ. ΑΞΙΑ	% ΦΠΑ
BA-2457030	ΒΡΑΧΙΟΝΑΣ ΣΤΗΡ.ΕΡΕΥΝΗΤΗ MQR-IV(max72mm)	ΤΕΜ	1	75,61	14,01	10,59	65,02	23,00
AOPOLAR5	ΔΙΟΠΤΡΑ ΠΟΛΙΚΗ ΓΙΑ EQ5	ΤΕΜ	1	39,84	14,01	5,58	34,26	23,00
9608681081	ΑΣΤΡΟΦΩΤΟΓΡΑΦΙΑ,ΟΔΗΓΟΣ ΣΥΜΒ.& ΨΗΦ.ΦΩΤΟΓ	ΤΕΜ	1	23,35	72,32	16,89	6,46	6,50

ΑΡΧΙΚΗ ΑΞΙΑ	ΑΞΙΑ ΕΚΠΤΩΣΗΣ	ΠΡΟΣΘ. ΕΚΠΤ.	ΣΥΝ. ΚΑΘ. ΑΞΙΑΣ	ΦΠΑ	ΣΥΝ. ΑΞΙΑΣ ΕΙΔΩΝ	ΕΞΟΔΑ	Φ.Π.Α. ΕΞΟΔΩΝ	**ΠΛΗΡΩΤΕΟ**
138,80	33,06	0,00	105,74	23,26	129,00	0,00	0,00	129,00

ΠΡΟΗΓ. ΥΠΟΛΟΙΠΟ	ΝΕΟ ΥΠΟΛΟΙΠΟ	ΣΥΝ. ΠΟΣΟΤΗΤΑΣ	ΩΡΑ ΕΝΑΡΞΗΣ	ΩΡΑ ΠΑΡΑΔΟΣΗΣ	Ο ΕΚΔΟΤΗΣ	Ο ΠΑΡΑΛΑΒΩΝ
0,00	0,00	3	1:01:50μμ			

ΑΝΑΛΥΣΗ Φ.Π.Α. ΚΑΤΑ ΣΥΝΤΕΛΕΣΤΗ

% ΦΠΑ	ΚΑΘΑΡΗ ΑΞΙΑ	ΑΞΙΑ ΦΠΑ	ΣΥΝΟΛ. ΑΞΙΑ
6,50	6,46	0,42	6,88
23,00	99,28	22,84	122,12
0,00	0,00	0,00	0,00

ΠΑΡΑΤΗΡΗΣΕΙΣ *Τα εμπορεύματα ταξιδεύουν για λογαριασμό και με την ευθύνη του αγοραστή

- ΣΑΣ ΕΝΗΜΕΡΩΝΟΥΜΕ ΟΤΙ ΒΑΣΕΙ ΤΟΥ ΝΟΜΟΥ Ν. 2472/97 ΤΗΡΟΥΜΕ ΤΑ ΠΡΟΣΩΠΙΚΑ ΣΤΟΙΧΕΙΑ ΣΑΣ ΣΤΟ ΑΡΧΕΙΟ ΜΑΣ ΚΑΙ ΕΧΕΤΕ ΠΡΟΣΒΑΣΗ ΣΕ ΑΥΤΑ ΣΥΜΦΩΝΑ ΜΕ ΤΟ ΝΟΜΟ.
- ΓΙΑ ΚΑΘΕ ΔΙΑΦΟΡΑ ΑΠΟ ΤΗΝ ΠΑΡΟΥΣΑ ΣΥΝΑΛΛΑΓΗ, ΣΥΜΦΩΝΕΙΤΑΙ ΡΗΤΩΣ ΟΤΙ ΑΡΜΟΔΙΑ ΕΙΝΑΙ ΤΑ ΔΙΚΑΣΤΗΡΙΑ ΘΕΣΣΑΛΟΝΙΚΗΣ.

05266C59E7DD950E0561616EBFDF0FF6833FDB41 0011 00006825 1308301309 EPX10019335

Επίσημος Αντιπρόσωπος

ΤΟ ΚΕΛΑΡΙ
ΣΟΥΠΕΡ ΜΑΡΚΕΤ
Ι. ΙΑΤΡΙΔΗΣ-Β. ΜΠΟΥΤΣΙΟΥ Ο.Ε.
ΥΠΟΚ/ΜΑ:ΡΟΔΟΛΙΒΟΣ ΤΗΛ. 23240 72187
Α.Φ.Μ. 092985372 Δ.Ο.Υ. Α' ΣΕΡΡΩΝ

ΔΕΛΤΙΟ ΑΠΟΣΤΟΛΗΣ - ΤΙΜΟΛΟΓΙΟ

(Για πώληση αγαθών)

ΣΤΟΙΧΕΙΑ ΠΕΛΑΤΗ

ΕΠΩΝΥΜΙΑ ΓΕΝΙΚΟ ΛΥΚΕΙΟ Ν. ΣΙΧΩΝΗΣ

ΕΠΑΓΓΕΛΜΑ

ΔΙΕΥΘΥΝΣΗ Ν. ΣΙΧΩΝΗ ΠΟΛΗ ΣΕΡΡΕΣ

ΣΚΟΠΟΣ ΔΙΑΚΙΝΗΣΗΣ

ΤΟΠΟΣ ΑΠΟΣ. ΤΟΠΟΣ ΠΡΟΟΡΙΣ.

ΗΜΕΡΟΜΗΝΙΑ 27/6/2013

Α.Φ.Μ. ΟΡΟΣΗΜΟΣ

Δ.Ο.Υ. ΕΔΡΑΣ Α' ΣΕΡΡΩΝ

ΠΕΡΙΓΡΑΦΗ ΕΙΔΟΥΣ	ΠΟΣΟΤΗΤΑ	ΤΙΜΗ ΜΟΝΑΔΟΣ	ΑΞΙΑ ΕΥΡΩ ΠΟΥ ΥΠΟΚ. ΣΕ Φ.Π.Α. 13 %	23 %
ΚΟΚΑ ΚΟΛΑ 1,5 Lit	12	1,25		15.00
ΠΟΡΤΟΚΑΛΑΔΑ 1,5 Lit	12	1,25		15.00
ΧΥΜΟΣ 1 Lit	12	1.50		18.00
ΠΛΑΣΤ. ΣΥΣΚΕΥΑΣΙΑ 50τ	5	0,65		3,25
ΠΙΑΤΑ ΣΤΑ 20τ	8	1.00		8.00
ΧΑΡΤΟΠΕΤΣΕΤΕΣ	5	0,40		2.00
ΚΕΦΑΣΜΑΤΑ	2	7,80	15.60	
Εφαπλίδα				

ΠΟΣΟΤΗΤΑ ΟΛΟΓΡΑΦΩΣ ΑΡΙΘΜΗΤΙΚΩΣ

ΑΞΙΑ ΕΥΡΩ ΟΛΟΓΡΑΦΩΣ

ΣΥΝΟΛΟ	15.60	61,25
Φ.Π.Α	2.03	14.09
ΣΥΝΟΛΟ ΕΜΠ/ΤΩΝ	76.85	
ΣΥΝΟΛΟ Φ.Π.Α.	16.12	
ΣΥΝΟΛΟ ΠΛΗΡΩΜΗΣ	92.97	

ΩΡΑ ΕΝΑΡΞΗΣ ΑΠΟΣ. ____ ΠΑΡΑΔΟΣΗΣ ____

σταυρου υπογραφειο τηλ 2324022244

Ο ΠΑΡΑΔΟΥΣ Ο ΠΑΡΑΛΑΒΩΝ

PROJECT MATERIAL

Astronomical Measurements in Ancient Greece

General Lyceum of Nea Zichni
Spring 2013

Aim

Combining observations of the Earth, the Moon and the Sun with geometry and trigonometry knowledge, we will repeat the measurements carried out by Ancient Greek philosophers in order to estimate the radius of the Earth, the Moon and the Sun and the distances between the Earth and the Moon, and the Earth and the Sun.

Introduction

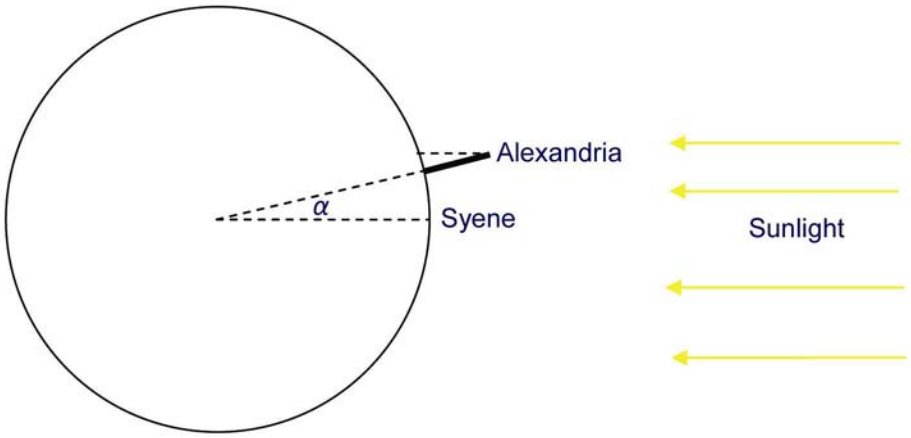
Casual sky observations reveal that heavenly bodies trace the same paths year after year. But only these observations do not suffice to estimate the sizes or the distances of these objects. In fact, up to 150 years ago we were not even aware of the true size of the Universe in which we live. Modern observations which estimate the diameter of the Universe at approximately 28 billion light years are based on older measurements of smaller distance scales (distances of far away galaxies), which are based on older measurements of even smaller distances (distances of nearby galaxies), which rely on smaller distance measurements (distances of far away and nearby stars), which were made possible only after distance measurements of our own solar system objects were carried out. Therefore, our cosmic distance scale ladder was initially founded on the pioneering efforts of the people who first were able to measure the distances between the Earth and its closest massive object, the Moon, and the Earth and its closest star, the Sun.
These measurements were first carried out about 2500 years ago, by Ancient Greek philosophers, like Eratosthenes from Cyrene (276 – 196 B.C.) and Aristarchus from Samos (310 – 230 B.C. approx.). Eratosthenes held the view that the Earth was spherical long before Galileo made a similar proposal and with simple observations was able to accurately measure the radius of the Earth. Aristarchus suggested, long before Copernicus put forward his model of our solar system, that the Sun was at the center of the known Universe and that the Earth and the planets revolved around the Sun, while the stars are at huge distances from the Sun. Using this model he was able to measure the sizes of the Moon and the Sun and estimate their distances from the Earth.
And all these measurements in Ancient Greece were made without the use of telescopes or other similar instruments, which allow for accurate observations. Moreover, the observations of the time did not allow for easy verification and acceptance of the models proposed by Eratosthenes and Aristarchus, so most people at the time held other views for the Universe. We will repeat the measurements carried out by these pioneering philosophers, demonstrating that the methods they suggested are correct and can yield very accurate results when combined with modern techniques.

The Earth's radius

This measurement was carried out by Eratosthenes using a very simple model for the Earth and the Sun, according to which:

a) the Earth is spherical, as can be deduced from observations of the Earth's shadow on the Moon during eclipses of the Moon and by the way a ship setting out from a port towards the open sea disappears in the horizon, and
b) the Sun is at infinitely large distance form the Earth so that its rays arrive at the Earth parallel to each other.

Eratosthenes knew that at noon on one particular day (summer solstice) in the town of Syene in Egypt (present-day Aswan) the Sun is reflected in the bottom of a deep vertical well without casting any shadows on the water from the sides. Therefore, at that time the Sun lies exactly at the zenith, directly over the town. But this never happened in Alexandria, were Eratosthenes lived, and even at that time all objects in Alexandria cast shadows. This cannot happen if the Earth is flat and the Sun is very far away and Eratosthenes realized that the phenomenon was a direct consequence of the Earth's curvature and could be used to measure the Earth's radius. Measuring the length of the shadow of a vertical stick at Alexandria at noon on summer solstice he was able to deduce that the sun rays were meeting the Earth with an angle of α=7,2 degrees (one fiftieth of a complete circle).



He then used the relation:

$$\frac{\text{Distance Syene-Alexandria}}{\text{Circumference of the Earth}} = \frac{7,2^{o}}{360^{o}}$$

and was able to estimate the circumference of the Earth, after having the distance between Alexandria and Syene measured and found about 805 km.

From the above what did Eratosthenes found for the circumference and the radius of the Earth?

(measured values appear in red, bibliography values appear in blue)

Circumference of the Earth: 40250 km

Radius of the Earth: 6406 km

Which are todays accepted values?

Circumference of the Earth: 40074 km

Radius of the Earth: 6378 km

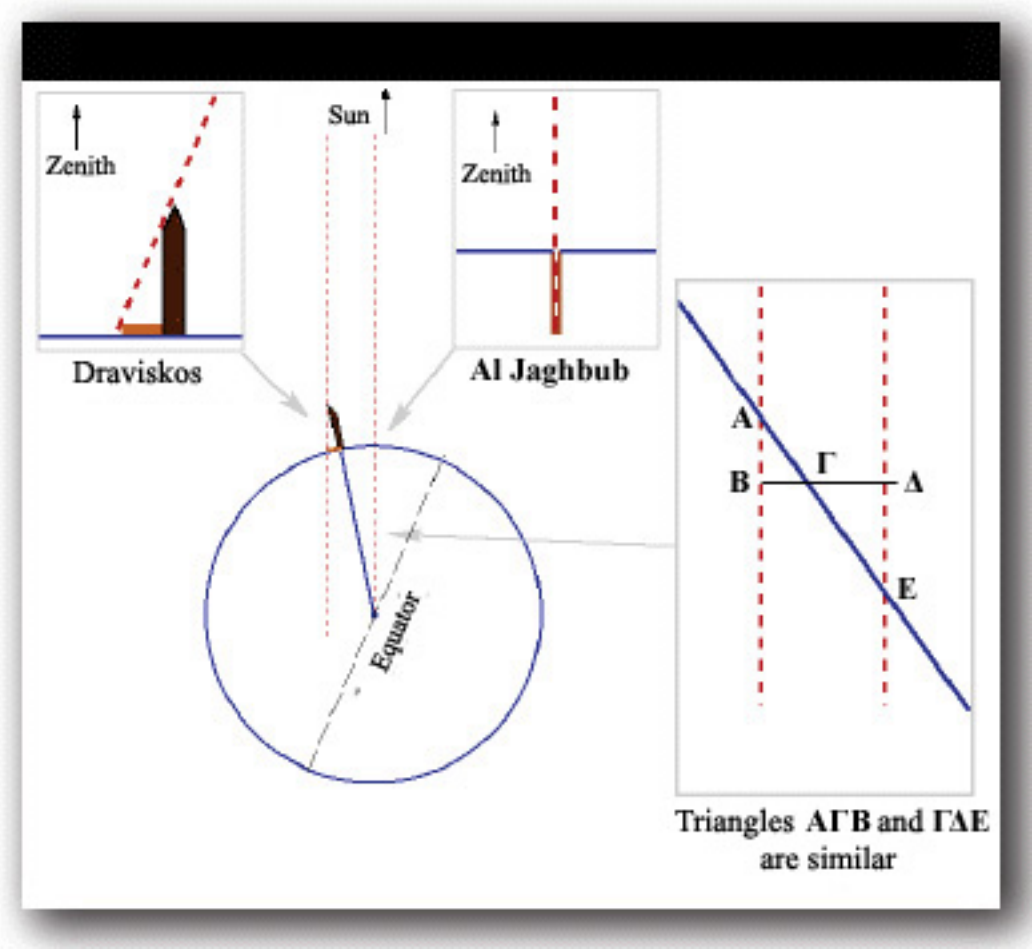
Measurement activities

In the Sahara desert, in Al Jaghbub there is a deep vertical well with water, which has been observed every year at noon on the summer solstice not to cast any shadows in the water from its sides. On the same day you happen to be at the village of Draviskos, nearby Nea Zichni, and at noon, exactly when the sun is directly over Al Jaghbub, you take a picture of a tree with its shadow, in order to repeat Eratosthenes measurements.

From the similar triangles ΑΒΓ and ΓΔΕ we see that

$$\frac{\text{Tree height}}{\text{Tree shadow length}} = \frac{\text{Earth radius}}{\text{Distance Draviskos-Al Jaghbub}}$$

as can be verified from the picture below.



Using a ruler measure the height of the tree and the length of its shadow from the above photograph.

Height of tree: 7 cm

Length of tree's shadow: 2 cm

In order to estimate the distance between Draviskos and Al Jaghbub you can use a map from the Internet, like the one shown below. In this map measure the distance between the two places in cm and then convert it to km, using the scale shown on the map.

Distance between Draviskos and Al Jaghbub on the map in cm: 13.4 cm

Length in cm of 500 km according to the map's scale: 3.5 cm

Distance between Draviskos and Al Jaghbub in a straight line in km: 1914 km

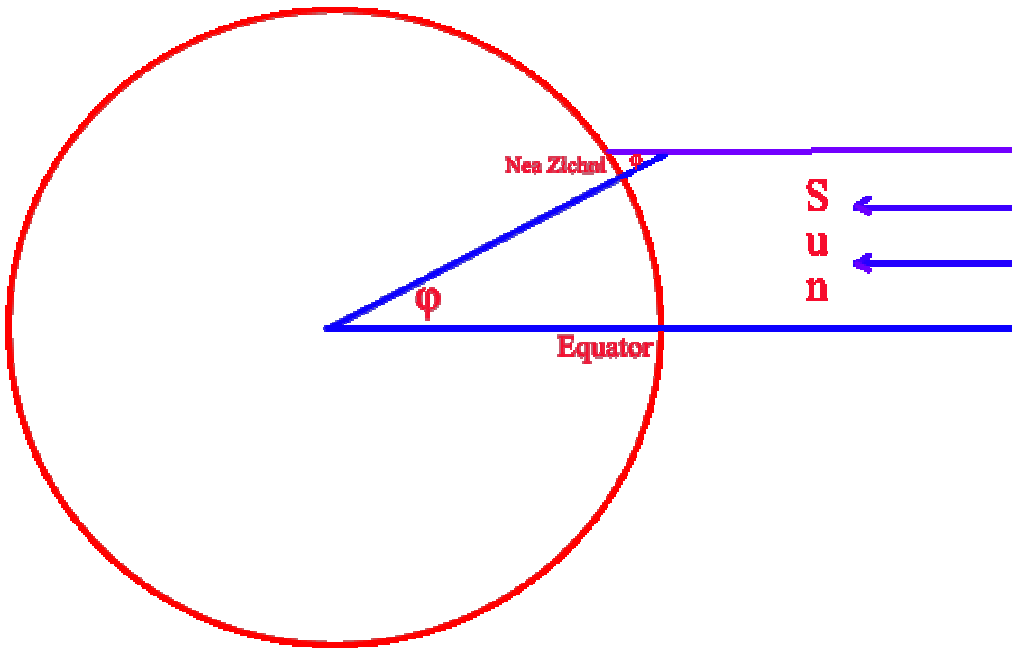
Using the measurements you made above estimate the radius of the Earth:

Radius of the Earth: 6699 km

What's the error in your estimate compared to the accepted value?

Error of estimate: 5%

Another way to do the same measurement is by utilizing the observation that on the day of spring equinox the length of the day equals the length of the night. This happens because at noon of this day the Sun is directly over the equator. Then, measuring the angle at which the sun rays fall on Nea Zichni at that time, is a direct measurement of Nea Zichni's geographic latitude, as can be seen on the graph below.



At noon on spring equinox (13.00 p.m. local time on 20th March 2013) we measure the height of a metal rod and then we place it vertical in the schoolyard and measure its shadow. Write down your measurements:

Height of the metal rod: 79.2 cm
Length of its shadow: 68.9 cm

By using trigonometry (or constructing an orthogonal triangle and measuring the angles on the construction) we find that the angle with which the sun rays meet the ground in Nea Zichni and hence the geographic latitude of Nea Zichni. Write down your finding:

φ = 41.022 degrees

From software like Google Earth we can find that the latitude for the Lyceum of Nea Zichni. What is it?
Nea Zichni latitude: 41.027 degrees
What is then the error in the estimate of the geographic latitude of Nea Zichni?
Error: 0.01%

From this result we can then estimate the circumference of the Earth since

$$\frac{\text{Distance Nea Zichni-Equator}}{\text{Circumference of the Earth}} = \frac{41,022^{o}}{360^{o}}$$

We use Google Earth to measure the distance from Nea Zichni to the equator. We find:

Distance of Nea Zichni to equator: 4543.6 km

Circumference of the Earth: 39874 km

Radius of the Earth: 6346 km

Error of measurement: 0.5%

This is a very accurate measurement indeed!

The size and the distance of the Moon

In order to measure the size of the Moon we will follow Aristarchus and use observations of lunar eclipses. Aristarchus measured the time it took for the Moon to pass through the Earth's shadow during a total lunar eclipse and compared this time to the time it takes the Moon to move in the night sky by one full lunar diameter. He found that this ratio is about 8/3 and thus, if the Sun is infinitely far and the sun rays traveled parallel to each other when reaching the Earth, this ratio is how larger the diameter of the Earth is from the diameter of the Moon. So, using Aristarchus measurements, we find

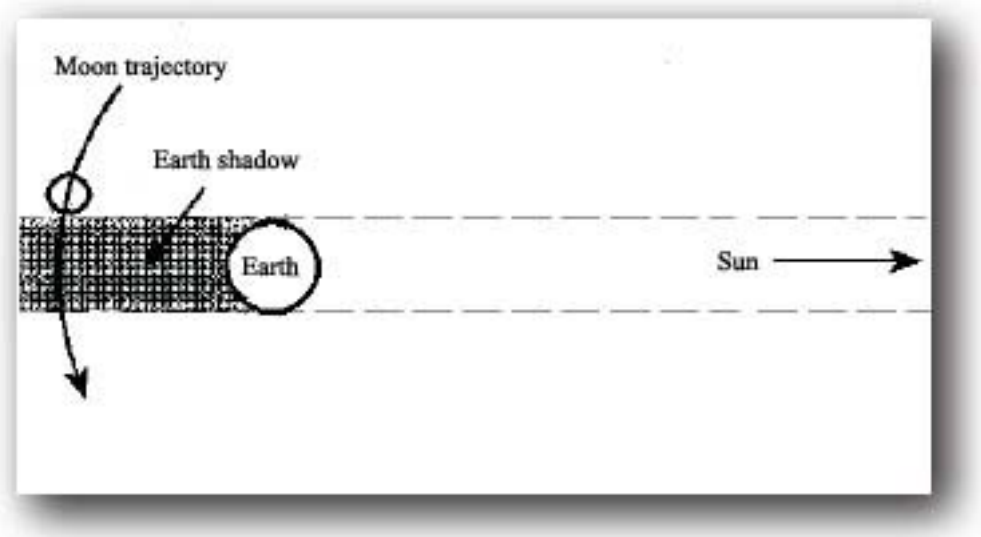
Radius of the Moon: 2380 km

What is the today accepted value?
Radius of the Moon from bibliography: 3476 km

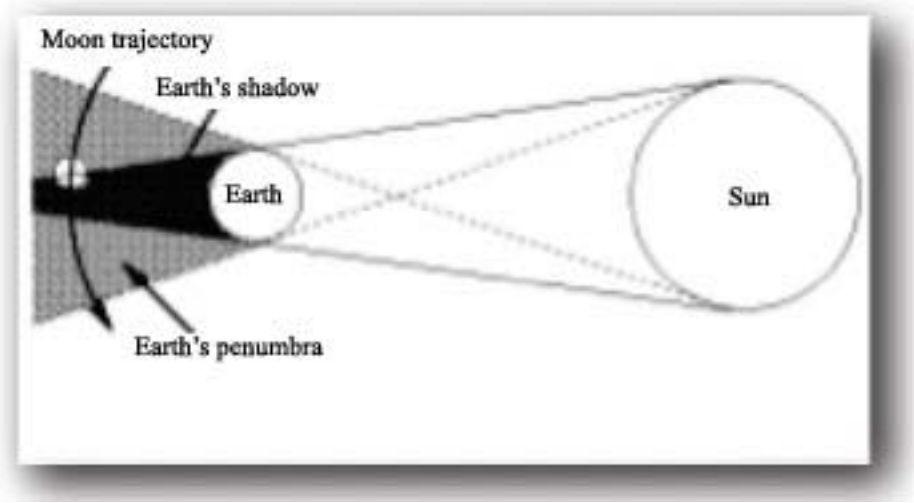
Why do you think there is a large error in this estimate?
The Sun is not infinitely far away and the sun rays cannot be though of as being parallel over such large distances as the length of the shadow of the Earth. Therefore the model used by Aristarchus needs to be corrected.

This model contains the following elements:

a) The Earth is spherical
b) the Sun is infinitely far from the Earth and the sun rays are parallel to each other when they reach the Earth
c) the Moon revolves around the Earth so that at some point it comes inside the Earth's shadow and thus lunar eclipses happen
This model is described in the graph below.

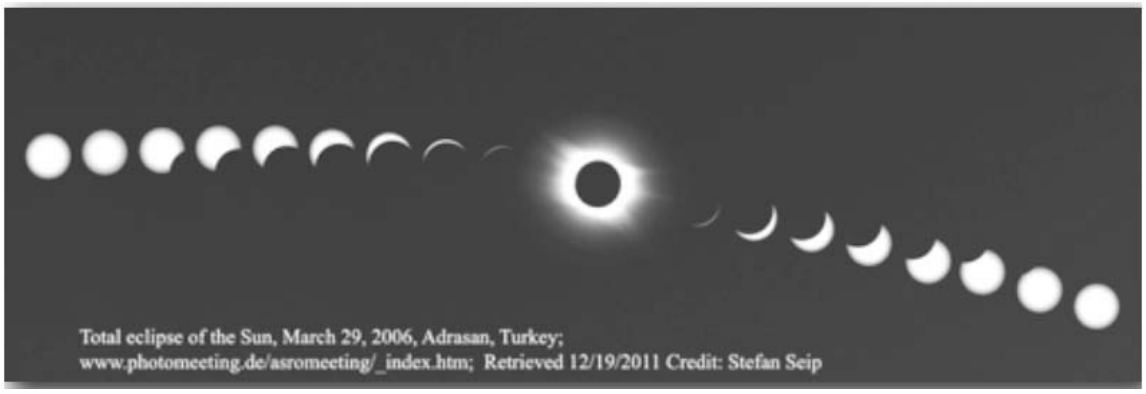


However, the Sun is not infinitely far and the sun rays are not completely parallel. A better model of a lunar eclipse is shown in the graph below, from which it can be inferred that during a lunar eclipse the Moon traverses a distance smaller than the diameter of the Earth.



In order to estimate the length of the shadow of the Earth compared to the Earth's diameter, it suffices to measure the distance of the shadow cast by a round metal coin held against the Sun at a distance such that it just hides the solar disk. Such an observation however is dangerous for the naked eyes and we therefore contact a similar observation for the Moon, since, as already noticed by Ancient Greeks, the Moon and the

Sun subtend equal angles in the sky. This can also be seen in the picture below, since the disk of the Moon is just equal to the disk of the Sun and covers it exactly in a solar eclipse.



Total eclipse of the Sun, March 29, 2006, Adrasan, Turkey;
www.photomeeting.de/asromeeting/_index.htm; Retrieved 12/19/2011 Credit: Stefan Seip

If we then hold a 2 cent coin with a diameter of 1.9 cm, in front of our eye at such a distance that the disk of the Moon matches the size of the coin we find that we have to place the coin at approximately 2 meters and 5 centimeters away (2.05 m). In other words, the ratio of the distance of the coin to our eye to the diameter of the coin is

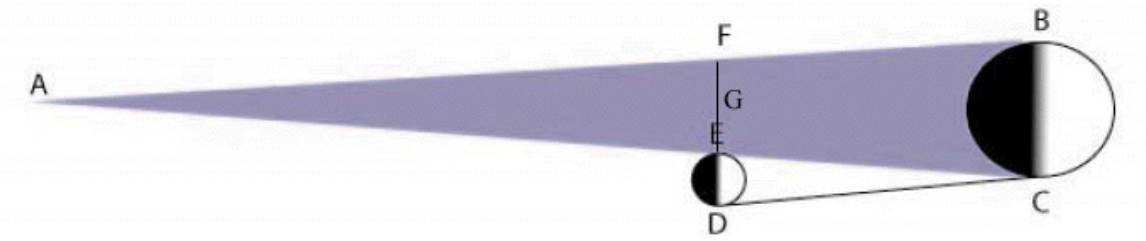
$$\frac{\text{length of coin shadow}}{\text{coin diameter}} = \frac{205\text{ cm}}{1{,}9\text{ cm}} \cong 108$$

It is apparent that the same holds for the shadows cast by the Earth and the Moon due to the sun rays. Therefore the length of the shadow of the Earth equals to

$$\text{Length of the shadow of the Earth} = 108 \times \text{ Diameter of the Earth}$$

But the Earth is almost at the tip of the Moon's shadow, as can be seen during solar eclipses and therefore the length of the shadow of the Moon is equal to the mean distance between the Earth and the Moon. Thus:

$$\frac{\text{length of shadow of the Moon}}{\text{diameter of the Moon}} = \frac{\text{distance Earth-Moon}}{\text{diameter of the Moon}} \cong 108$$



As can be seen from the above graph, where the isosceles triangles AFE and ABC are similar, the ratio of AG to FE is also the same. Thus

$$\frac{AG}{FE} \cong 108$$

and since the length of the shadow of the Earth is equal to the length of AG plus the distance between the Earth and the Moon, we find that:

Length of Earth's shadow = AG + distance Earth-Moon = 108xFE + 108xMoon diameter

or

108 x Earth diameter = 108 x (FE + Moon diameter)

or

Diameter of the Earth = FE + Diameter of the Moon

Utilizing then the measurement carried out by Aristarchus and a more realistic model we can estimate quite accurately the diameter of the Moon. In order to measure ourselves the length FE we can use a photograph of a lunar eclipse, like the one below. In this we need to estimate how large is the shadow of the Earth falling on the Moon compared to the Moon's diameter. This is the length FE in Moon diameters.

How long (in cm) is the diameter of the Moon in this photograph?

Diameter of the Moon: 8.2 cm

Draw a curve at the edge of the shadow of the Earth on the Moon. Then draw the circle corresponding this arc (you can find the center of this circle by using two arc segments and finding the point of intersection of the perpendicular lines passing through their centers). Which is the diameter of this circle (in cm)?

Diameter of the shadow of the Earth: 20.5 cm

How many times longer is the diameter of the shadow of the Earth compared to the diameter of the Moon?

Length of FE (in Moon diameters): 2.5

Using the value of the radius of the Earth you found earlier, how long is the diameter of the Moon?

Diameter of the Moon: 3626 km
Radius of the Moon: 1813 km

What is your error compared to the accepted value?

Error in measurement: 4.3%

From the above measurements the distance of the Moon can be estimated, following Aristarchus ideas. How far is the Moon from the Earth?

Distance between the Earth and the Moon: 391608 km

Which is the mean distance between the Earth and the Moon according to the bibliography?

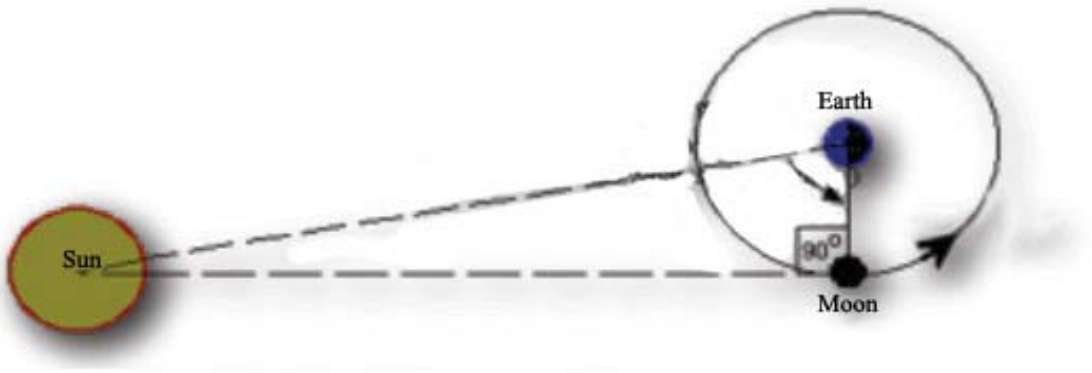
Mean Earth-Moon distance (bibliography): 384400 km

What is the error in your measurement?

Error in measurement: 1.9%

The size and the distance of the Sun

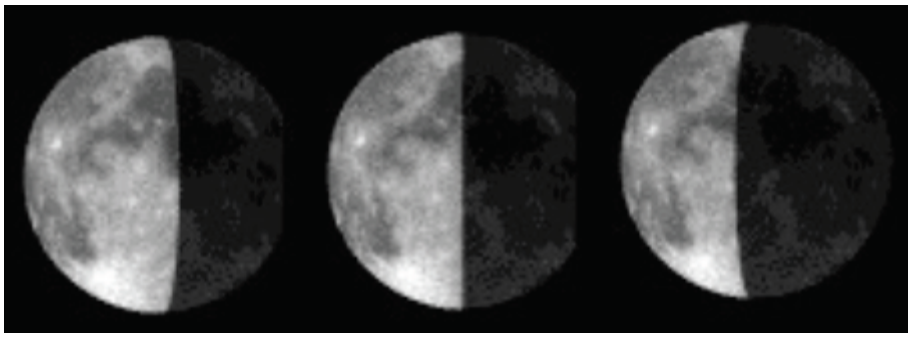
Aristarchus also found a way to estimate the distance of the Sun. His method relies on the observation that when the Moon is at first or last quarter, the angle between the Sun, the Moon and the Earth is a right angle as shown in the figure below.



Therefore the model used contains the following elements:
a) the Earth is spherical
b) the Sun is at a great distance from the Earth but not infinitely large, so that the sun rays are not parallel to each other when they reach the Earth
c) the Moon revolves around the Earth

By measuring the angle Sun-Earth-Moon when the Moon is at the phase of the first or last quarter and knowing the distance of the Moon, we can estimate the distance of the Sun. However, this angle is very close to 90 degrees and any offset is very hard to measure. Moreover it is also difficult to find the exact time when the Moon is at the first or the last quarter, as can be realized from the pictures below.

the first quarter



the last quarter

Aristarchus himself measured this angle to be about 87 degrees. This measurement has a large error. Later measurements by other Greek philosophers found this angle to approximately 89.5 degrees, while modern more accurate measurements yield a value of 89.853 degrees. Therefore, according to the above graph

$$\cos\theta = \frac{\text{Distance Earth-Moon}}{\text{Distance Earth-Sun}}$$

and thus, using the distance of the Moon estimated above and the modern measurements of θ, how long is the Sun away from the Earth?

Distance between the Earth and the Sun: 152635621 km

You have just measured the length of the Astronomical Unit!

What is the value accepted today?
Distance between Earth and Sun (bibliography): 149600000 km

What is the error in your estimate? 2%

We know, as stated above, that the angle subtended by the Sun as seen from the Earth is the same as the angle subtended by the Moon as seen by the Earth. Therefore, the ratio of the distance Earth-Sun to the diameter of the Sun is the same as the ratio of the distance Earth-Moon to the diameter of the Moon:

$$\frac{\text{distance Earth-Sun}}{\text{diameter of the Sun}} = \frac{\text{distance Earth-Moon}}{\text{diameter of the Moon}} \cong 108$$

From the above relation we can calculate the diameter and the radius of the Sun. We find that:

Diameter of the Sun: 1413292 km
Radius of the Sun: 706646 km

You have just measured the radius of a star!

What is the currently accepted value?

Radius of the Sun (bibliography): 696600 km

What's your error? 1.5%

Bibliography
Gavrilis K., Metaxa M., Niarchos P. And Papamihalis K. (2002), Elements of Astronomy and Space Exploration, Lyceum school textbook, Institute of Technology, Computers and Publishing, Athens. (in Greek)
Fowler M. (2009), Galileo and Einstein, Text for Physics 109, U Va Physics, last accessed on 10 Nov. 2012.

QUESTIONNAIRE ON ASTRONOMY

NAME: _____ DATE: _____

Using the scale below indicate how much each of the following statements is true by circling the appropriate number.

Not true at all	A little true	Somewhat true	Very true	Absolutely true
1	2	3	4	5

1. I enjoy Astronomy very much 1 2 3 4 5

2. I understand Astronomy easily 1 2 3 4 5

3. I don't care at all to what happens beyond Earth 1 2 3 4 5

4. Astronomy is boring 1 2 3 4 5

5. I do not understand at all what happens beyond Earth 1 2 3 4 5

6. Why Sun and Moon eclipses don't occur approximately once a month since the Moon is revolting around the Earth approximately once a month?

7. Why in the summer in Nea Zichni there are higher temperatures than in the winter?

8. Can we see Venus at midnight? Explain using a drawing.

Turn to the next page

9. Is it possible for a Sun eclipse to occur when the Moon is at first quarter? Explain with a drawing.

10. What is the phase of the Moon during a Moon eclipse? Explain with a drawing.

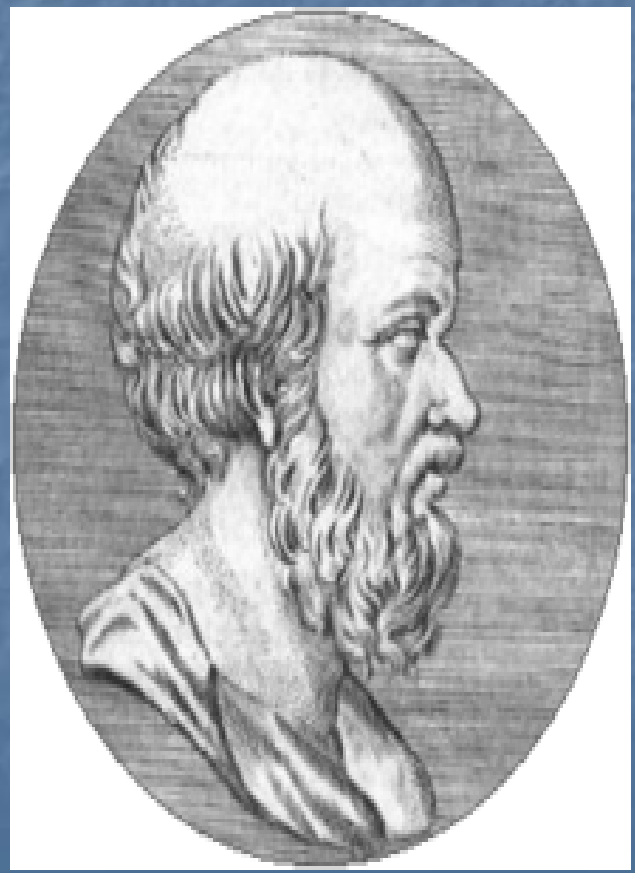
Mark the following questions as Right (R) or Wrong (W) by circling the appropriate letter and explain briefly your choice.

11. In the summer solstice the Sun is at the zenith of Nea Zichni. **R** **W**

12. In the spring equinox the Sun at noon is at the zenith of the equator. **R** **W**

13. When there is summer in Nea Zichni, the Earth is at the point of its path which is closest to the Sun. **R** **W**

How Eratosthenes measured the radius of the Earth



Eratosthenes' biography

- He was born in Cyrene (in present-day Libya)
- He lived, worked and died in Alexandria, the capital of the ptolemaic Egypt.
- He studied in Alexandria and claimed to also have studied for some years in Athens.
- He was appointed librarian by Ptolemy the 3rd of the Alexandrian Library, succeeding Zenodotos (236 B.C.)
- He never got married
- In 194 B.C. he was blinded and one year later he stopped eating and died.

His work

- He made several important contributions to Mathematics and he was a friend of the famous mathematician Archimedes.
- Around 225 B.C. he invented the armillary sphere, whch was widely used until the invention of the planetarium in 18th century.
- Around 240 B.C. he estimated the circumference of the Earth using the height of the Sun in the summer solstice in two different geographical locations, which lied in the same (approximately) meridian: in Elephantine island near Alexandria –were the Sun was at the zenith in the sky- and near Syene (present-day Aswan in Egypt).
- He invented the system of Earth's parallel cycles.

- He proposed that it is possible to travel along a parallel circle starting from Iberia and reach India, by sailing along the Atlantic Ocean. Stravon, who salvaged and made this theory known to us, also added that during this journey one might meet unknown areas of land.
- He also invented a way of calculating prime numbers, known as Eratosthenes' riddle.
- The term Geography is attributed to Eratosthenes

The measurement of the circumference of the Earth by Eratosthenes

One of the most important experiments ever accomplished in human history was the measurement of the circumference of the Earth by Eratosthenes in 3rd century B.C. Eratosthenes heard that in Syene (present-day Aswan) the sun at noon on the summer solstice casts its rays vertically and illuminates the bottom of a well. At the same time in Alexandria the sun's rays form a 7^o angle with the vertical direction. He then measured the distance between Alexandria – Syene and estimated with remarkable accuracy the circumference of the Earth.

Our measurements

Eratosthenes used a very simple model for the earth and the sun according to which

- A) the earth is spherical since its shadow on the moon is cyclical and because of the way a ship dissappears in the horizon when sailing away from a harbour and
- B) the sun lies at an infinitely long distance from the earth so that the sun's rays reach our planet parallel to each other.

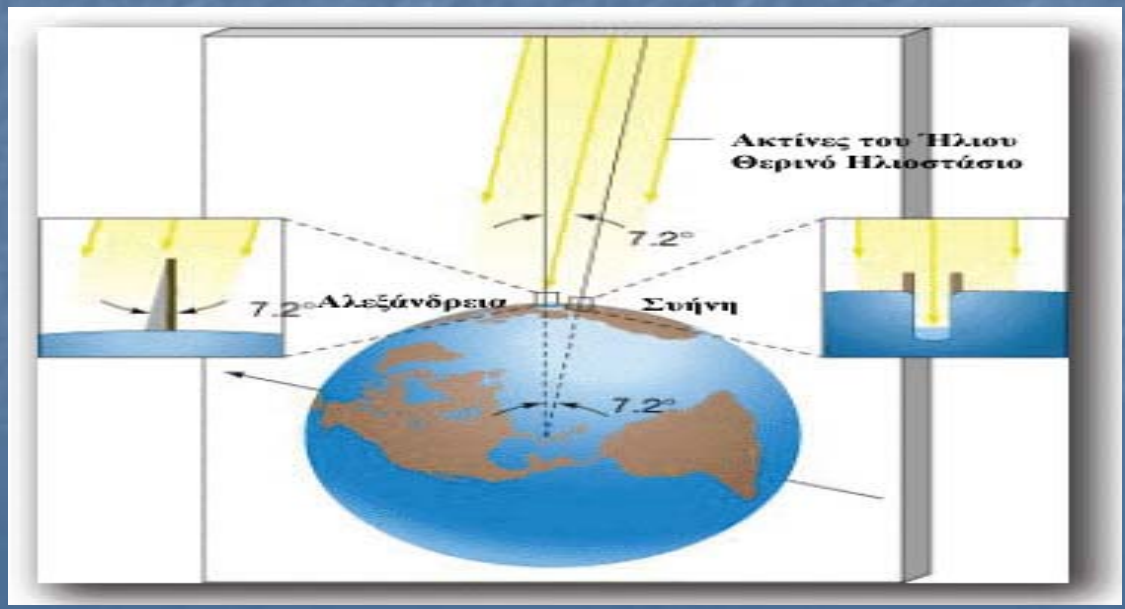
Measuring the length of the shadow of an obelisk and the height of the obelisk at noon of the summer solstice in Alexandria, Eratosthenes was able to estimate that the run's rays reached the Earth at a 7,2^{o} angle.

Then, from the analogy:

$\frac{\text{Distance Syene – Alexandria}}{\text{Circumference of the Earth}} = \frac{7.2^{o}}{360^{0}}$

he was able to estimate the circumference of the Earth and its radius, after the distance Syene – Alexandria was measured by special walkers and found about 805 Km.

From the above, the circumference of the earth is 40,250 km and the radius of the earth is 6406 km.



In Libyan Sahara, in Al Jaghbub oasis there is a well with water, where it has been found that every year, on the day of the summer solstice, the light from the sun falls straight into the well without casting shadows from the well's sides. At the same day (June 21st), from a photograph taken in Draviskos we repeated Eratosthenes experiment using the analogy

$$\frac{\text{Height of the tree}}{\text{Length of the shadow}} = \frac{\text{Radius of the Earth}}{\text{distance Draviskos-Al Jaghbub}}. \quad (1)$$

We found that the height of the tree is 8.5 cm, the length of its shadow is 2.4 cm and using to Google Earth we measured the distance Draviskos-Al Jaghbub and found it to be 1,865.85 km as shown in the picture below.

From relation (1) we estimated the radius of the earth to be equal to 6,608.3 km and in the question "how much are you in error compared to the accepted value" we found that our error is 232 km.

The following students participated:

- Babou Theodora
- Nikola Apostolia
- Avramidou Panayiota
- Liaouri Cleoneke
- Deliolan Theodora
- Aydini Migena

THE END

ASTRONOMICAL MEASUREMENTS IN ANCIENT GREECE

Section studied:

The size and the distance of the Moon

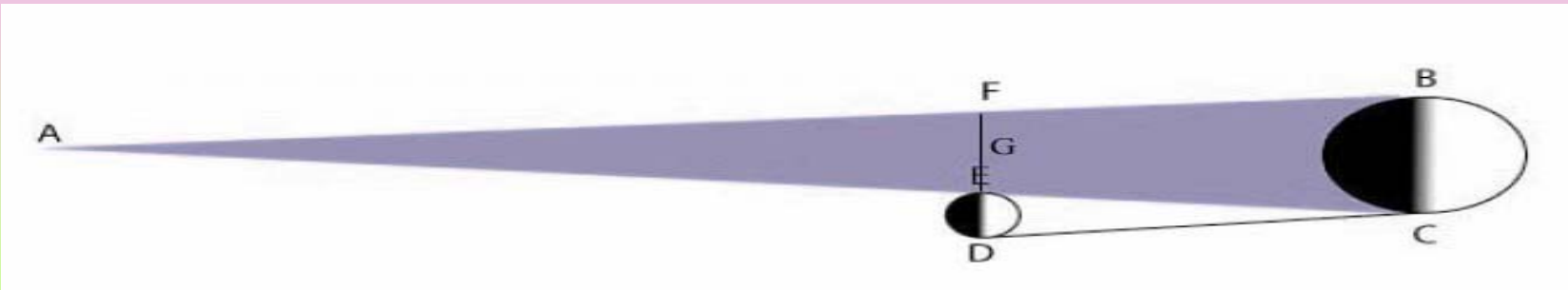
Aristarchus' theory

- The Earth is spherical
- The Sun lies at an infinitely long distance from the Earth and its rays reach the Earth parallel to each other
- The Moon revolves around the Earth so that at some point it lies in the Earth's shade and eclipses occur.

Based on this theory we implemented our study

The mathematical formula which guided us in all our measurements is:

Diameter of the Earth = FE + Diameter of the Moon

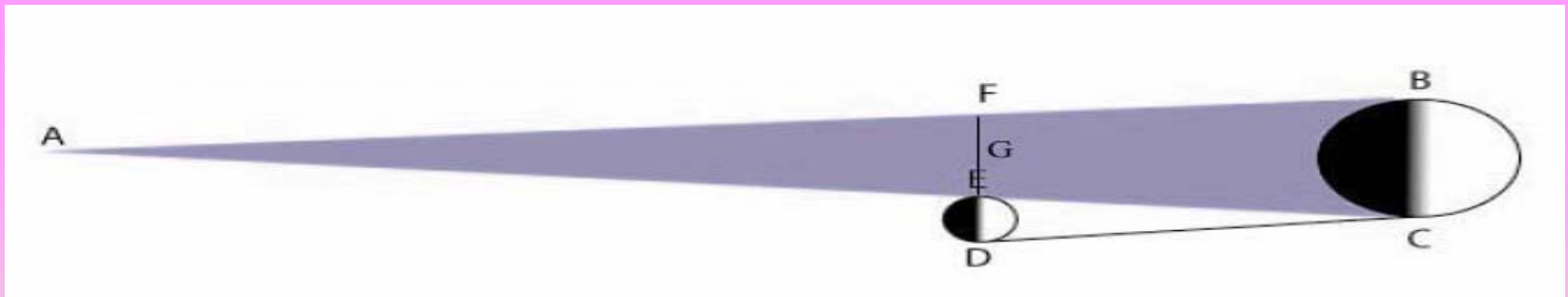


Measurements

- *The shadow of the Earth is 2.5 times greater than the diameter of the Moon*

Measurements

- ***The Diameter of the Earth is 3.5 times greater than the Diameter of the Moon***



Measurements

- ***We used the Diameter of the Earth from the results of the previous group:***

  6603 km
- ***The Diameter of the Moon is 3773 km***
- ***The distance Earth – Moon is approximately 108 times larger:***

  407.499 km

Accepted values for our measurements

- ***The Diameter of the Moon is 3476 km***
- ***While the distance between the Earth and the Moon is 384.403 km***

Notice: ***We had a relatively small deviation***

THE END

THANK YOU FOR YOUR ATTENTION !!!

Students:

Daphne Dimitriadou

Zoe Drossopoulou

Kalamari Kiriaki

Moutsiou Stefania

Pagona Chrysanthi

Charoupa Maria

The size and the distance of the Sun

The first estimate of the distance of the Sun and its diameter was carried out by

Aristarchus of Samos

Aristarchus of Samos

He was a Greek astronomer and mathematician. He is the first scientist who suggested the heliocentric model of the Solar System, positioning the Sun instead of the Earth in the center of the then known universe.

Distance and size of the Sun

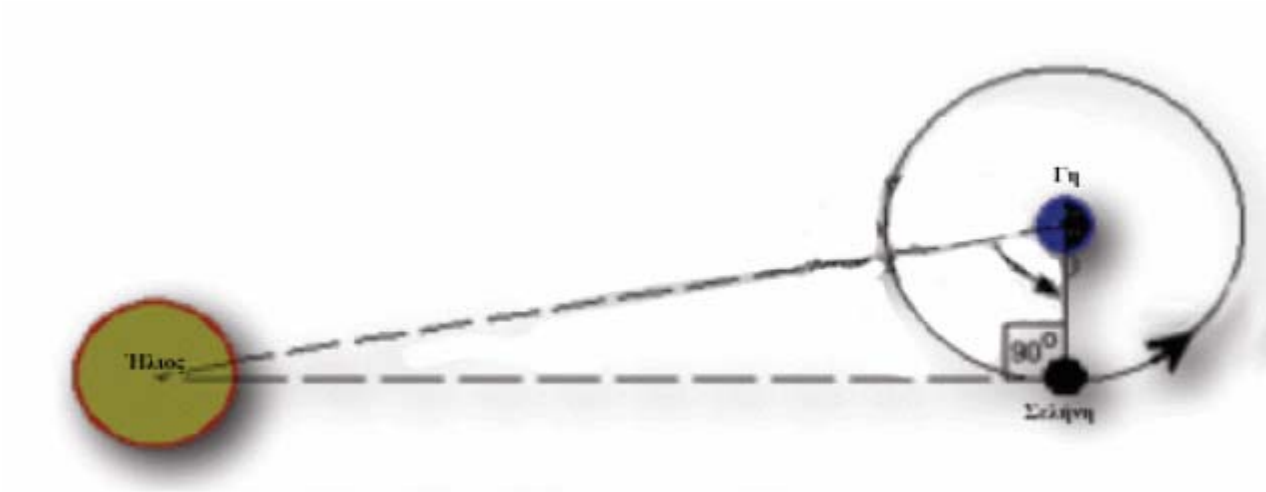
Aristarchus observed the motion of the Moon through the shadow of the Earth during an eclipse of the Moon. He estimated that the size of the Earth is 3 times greater than the diameter of the Moon.

Distance and size of the Sun

Using Eratosthenes' estimation of the circumference of the Earth of 42,000 km, he conjectured that the Moon has a circumference equal to 14,000 km. Today it is accepted that the Moon has a circumference equal to 10.916 km.

Distance and size of the Sun

Aristarchus observed/claimed that the sun, the moon and the earth form an almost right angle at the moment of first or the last quarter phase of the moon.



Distance and size of the Sun

Aristarchus estimated that the angle Earth-Moon-Sun was 87 degrees, using geometry correctly but with observational errors.

He concluded that the Sun was 20 times further from the Earth than the Moon. In reality the Sun is about 390 times further than the Moon.

Distance and size of the Sun

He noticed that the Moon and the Sun have approximately the same apparent size in the sky when viewed from the Earth and concluded that their diameters must be proportional to their distances from the Earth. Thus he conjectures that the Sun had a diameter 20 times greater than the diameter of the Moon, which is computationally sound and logical, but is also in error (since it is founded on data which are in error). Nevertheless, his estimation indicated that the Sun is clearly larger than the Earth.

Our measurements

We used modern estimations of the angle Earth-Moon-Sun at the moment of the first or last quarter phase of the Moon:

$$\varphi = 89{,}853^{o}$$

and used the results obtained from the other groups and the relation:

$$\cos\varphi = \frac{\text{Distance Earth-Moon}}{\text{Distance Earth-Sun}}$$

Our measurements

For the distance Earth-Sun we found:

155,907,054.1 km

which is very close to the accepted value
149,600,000 km

This distance is called
1 **Astronomical Unit (1 A.U.)**

Our measurements

Thus the Sun is 390 times further away than the Moon and according to Aristarchus' observations it has 390 times greater diameter than the diameter of the Moon.

Using Aristarchus' observations and the measurements of the other groups we find that the diameter of the Sun is

1,470,593 km

Our measurements

Our results are very close to the accepted value of

1,391,000 km

We have just measured the radius of a star!

THE END

Participating students

- Gerakis Ioannis
- Goumagias Ioannis
- Karipian Christos
- Mitsios Christos
- Moutaftsis Ilias
- Skederi Jenis
- Filippou Fotis

Student views

- This project is a fantastic experience because you can learn a lot of things. Such as we learn about astronomy and how ancient Greeks measured the size of the Earth. We learned about telescopes and observed the Sun, the Moon and Saturn.

- I like looking at the sky. Learning more about astronomy and using a telescope was really exciting. I learned many exciting things and how to use the shadows to measure the radius of the Earth. I taught my brother and his friends at junior high school about it when we presented there! I hope we will make more night observations in the future.

- I was amazed that we measured the radius of the Earth by measuring our shadows. I also liked watching Saturn and the Moon. I thought that the Earth is away from the Sun in the winter and near the Sun in the summer. But it’s the opposite! And Columbus was not the first one to say that the Earth is round.

- In this project I learned how to measure the radius of the Earth, the Moon and the Sun and how to recognize common constellations. I enjoyed very much to learn about the stars and the sky. My father has a telescope and we never used

it. I will use it to observe the things I learned. I liked that our school has a telescope and want to make more observations. It’s a pity that it snowed in our trip to Kastoria and coyld not observe anything.

- This is a very exciting project. We watched the Saturn with the rings, the Sun with sunspots and the surface of the Moon. We also learned how to measure the radius of the Earth and the distance to the Sun. After the project I study pictures to identify the craters of the Moon such as Aristarchus and Eratosthenes.

- I like astronomy and after the project I like it more. I learned many new things about the Earth, the Moon, the Sun, the stars and the constellations. We observed the Sun, the Moon and Saturn. It was fantastic. Too bad it was cloudy in the summer festival. Our teachers said we will observe more this year.

- In this project I learned about astronomy. I liked observing with the telescope and look forward to observing again. I liked to measure the shadows, too, but didn’t like to present to the other children.