Using methods of researching for exploring the Sun and other objects from the Solar System

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The goal of the project was to make explorations of the solar activity and conclusions about the sizes of different objects in the Solar System, using information from the Internet and from astronomical books.

By the work for this project we learnt how to calculate the Wolf number and to establish the solar activity. We compared the sizes of different Solar system objects and we learnt about their proportion. Using the Titius-Bode rule we calculated the distances from all of the Solar system planets to the Sun and we showed them graphically. We established that they are not the same as the real and the rule is not completely right.

We made an animation of the Sun photos made by one of the students in the summer astronomical camp "Beli Brezi", using the SalsaJ software and we learnt about its rotation. We also used the Scratch software and we made a test which checks what have we learnt by working for the project.

SalsaJ can be downloaded for free from
http://www.euhou.net/index.php/salsaj-software-mainmenu-9[2]
and Scratch - from
http://scratch.mit.edu/[3]

Main theories:

1. Wolf Number:

The change of the sunspot number by the time has been established by the Danish astronomer Gorebov in the 70s of the 18th century. He based on his

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observations of the Sun in the period 1761 – 1769. The connection between the changing sunspot number has been discovered again in 1843 by Shwabe who is considered for the person who discovered it for first time.

In 1848 г. Wolf shows special index for the sunspot number.

$W = k (10g + f)$,

where f is the sunspot number, g – the number of the groups of sunspots and k –coefficient showing the possibility of the telescope, of the atmosphere and the experience of the observer.

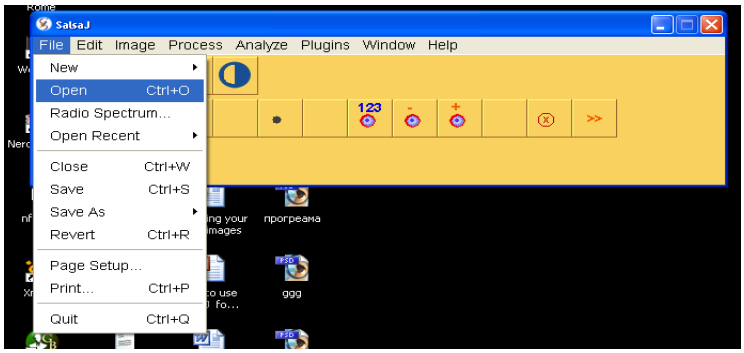
2. Titius-Bode rule for measuring the distance between the Solar system planets and the Sun.

Methodology:

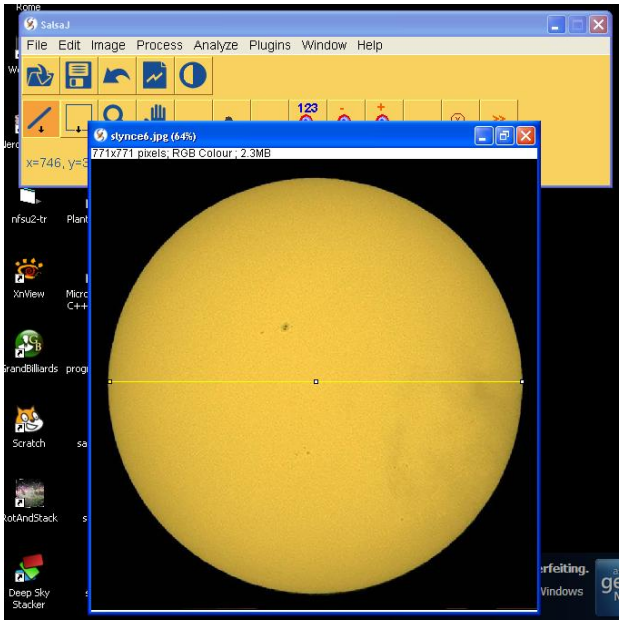
Using the SalsaJ software for measuring sunspot's diameter:

Explaining:

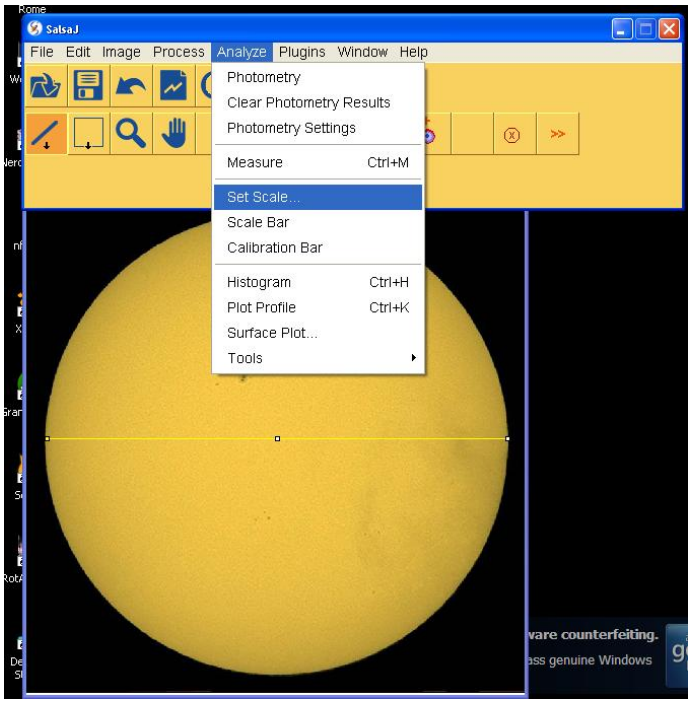
1. Open the image:



2. Draw a line on the diameter of an object whose diameter you know (in this case it is the Sun):

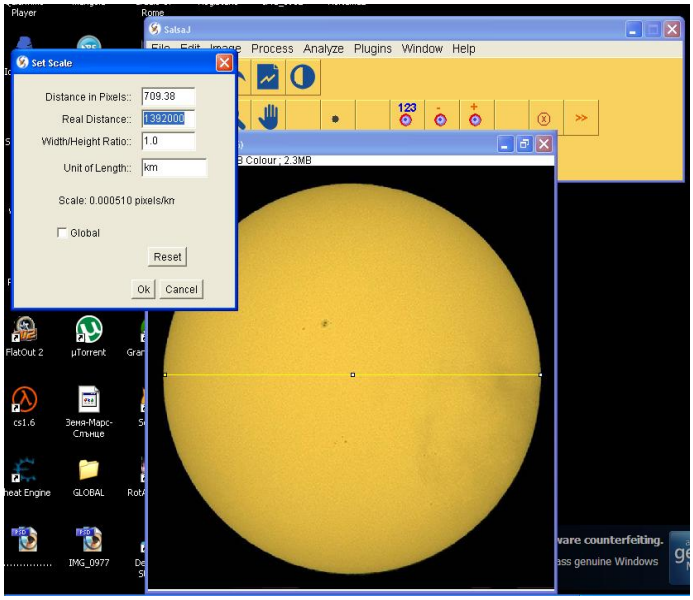


3. From the menu “Analyze” press “Set Scale…” :

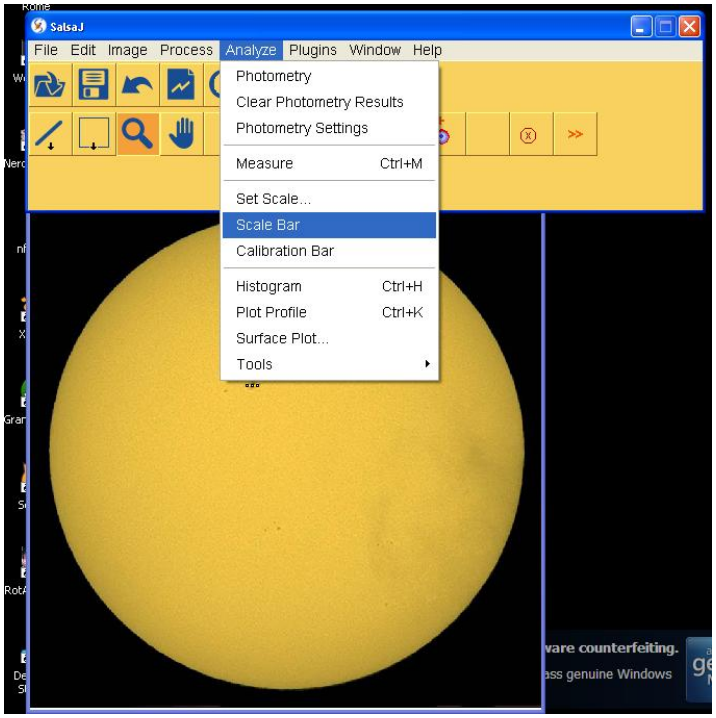


4. In the window write the diameter of the object and press OK:

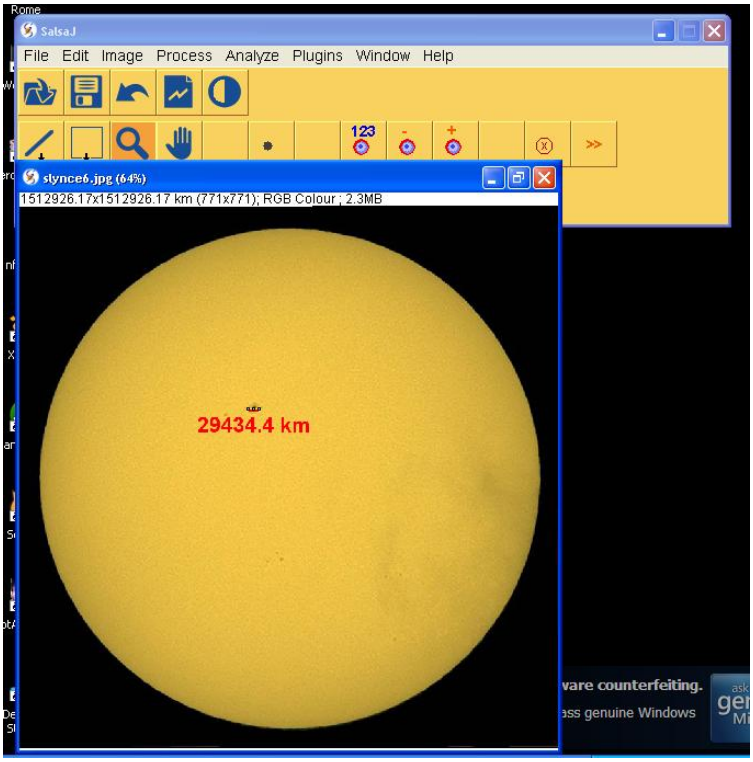
Then the program automatically calculates the scale.



5. Draw a line on the object you want to measure and in the menu “Analyze” press “Scale Bar”:



6. Then the program shows the diameter of the object we want to measure:



The animation of the Sun's rotation has been also done with this software. It can be done by using the menu "Image".

Research

1:

Our first task was to calculate the Wolf number by counting the sunspot number and the groups of sunspots. We used the formula:

W=k(10g+f),

where “g” is the groups of sunspots and “f” – the number of sunspots.

We admit that the coefficient “k” is 1.

We have also made a diagram in Microsoft Excel. With it we compare the results and we show the difference of the sun activity in the period 6^{th} – 12^{th} August 2012.

2:

Our second task was to compare the sizes of different Solar system objects with the sizes of the Earth and the Moon.

To make this we used the method of measuring with SalsaJ which we have already explained. After we made the measurements we used the information and made a diagram comparing the results.

3:

Our third task was to calculate the distance between Solar system planets and Sun using Titius-Bode rule. We compared the results with the real distances on two diagrams.

Here is the rule:

$a_n = 0,3.2^n + 0,4$,

where for Mercury n=∞, for Venus n=0, for the Earth n=1, for Mars – n=2, for asteroid belt – n=3, for Jupiter – n=4, for Saturn – n=5, for Uranus – n=6

4:

The next task was to compare the sizes of the planets on a diagram by starting with the smallest and finishing with the biggest. The information has been taken from the Internet.

We also made some diagrams comparing other features of the planets with the Earth.

5:

Next task was making an animation showing Sun's rotation using the SalsaJ software. We used photos of the Sun made by one of the students – Tsvetoslav Nikolov. Here is the link for the video:

http://www.youtube.com/watch?v=ppSvpJxcM-s

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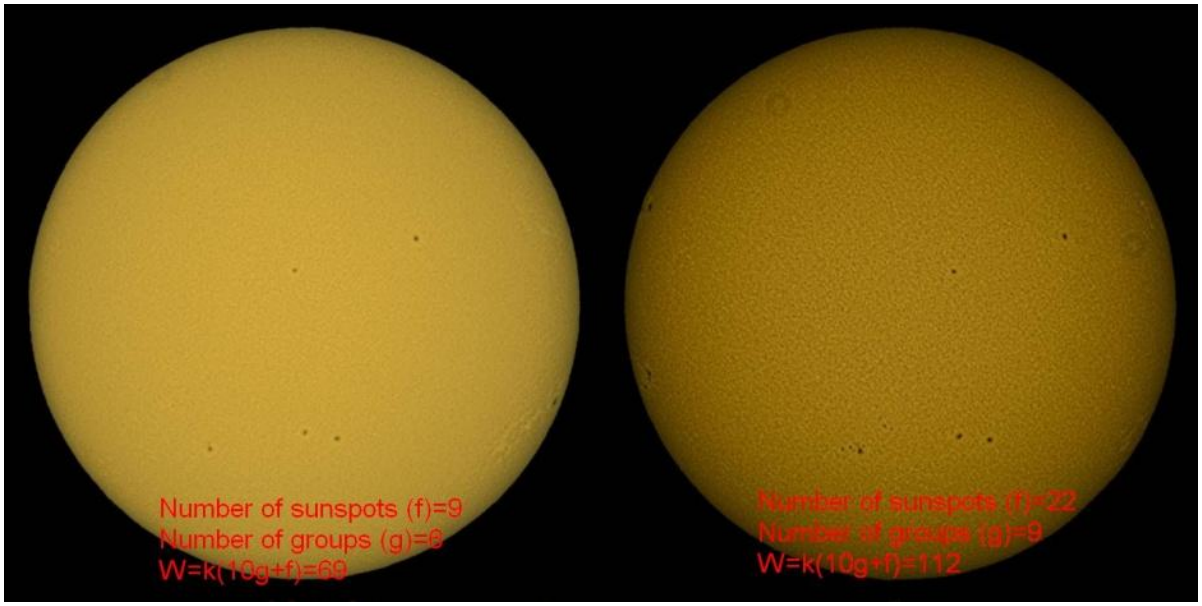
Our last task was lerning the programming software Scratch and making a test with it about the solar system.

Some of the diagrams include tables with the information. They make the diagrams easier to read.

Data Analysis

Photo 1:



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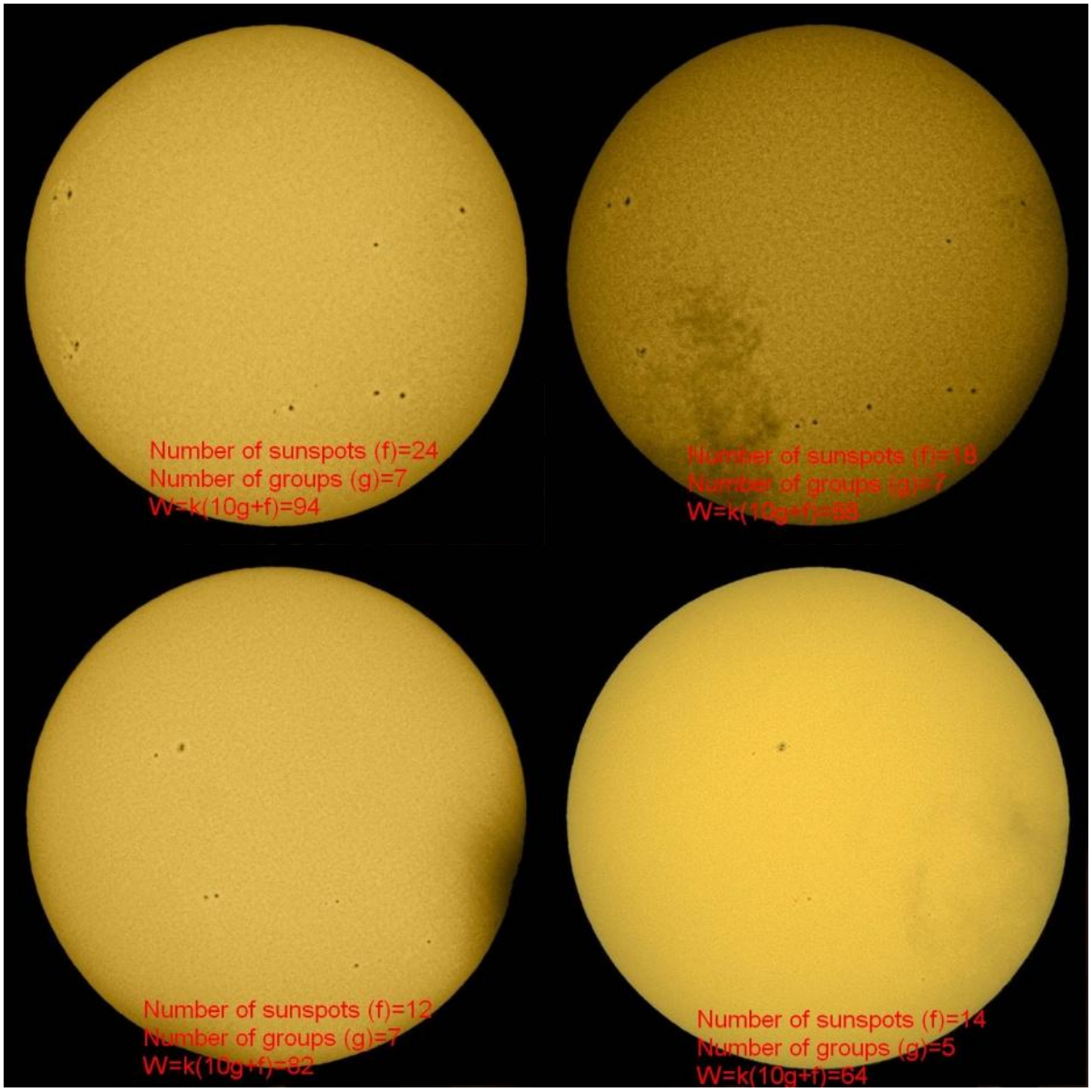


These photos show the calculations of the Wolf number using the formula.

Diagram 1:

The diagram shows the different sun activity in the period 6^{th} – 12^{th} August 2012.

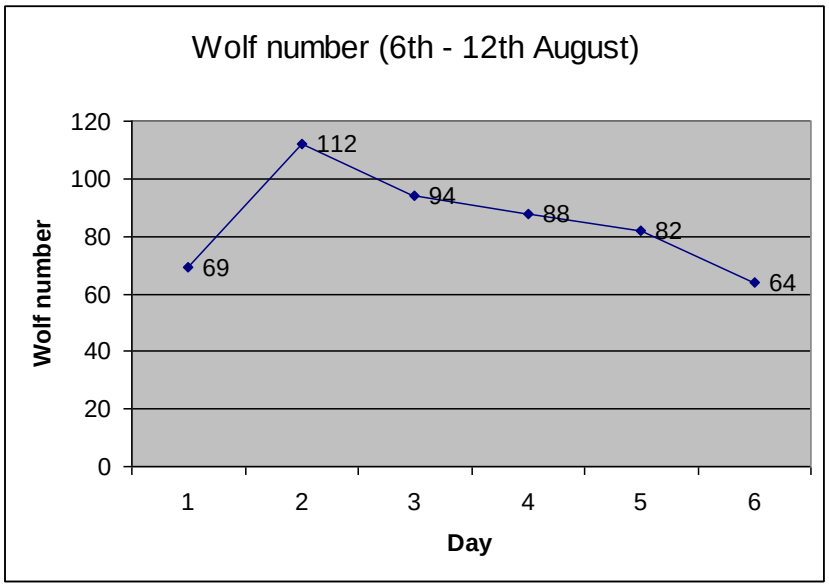
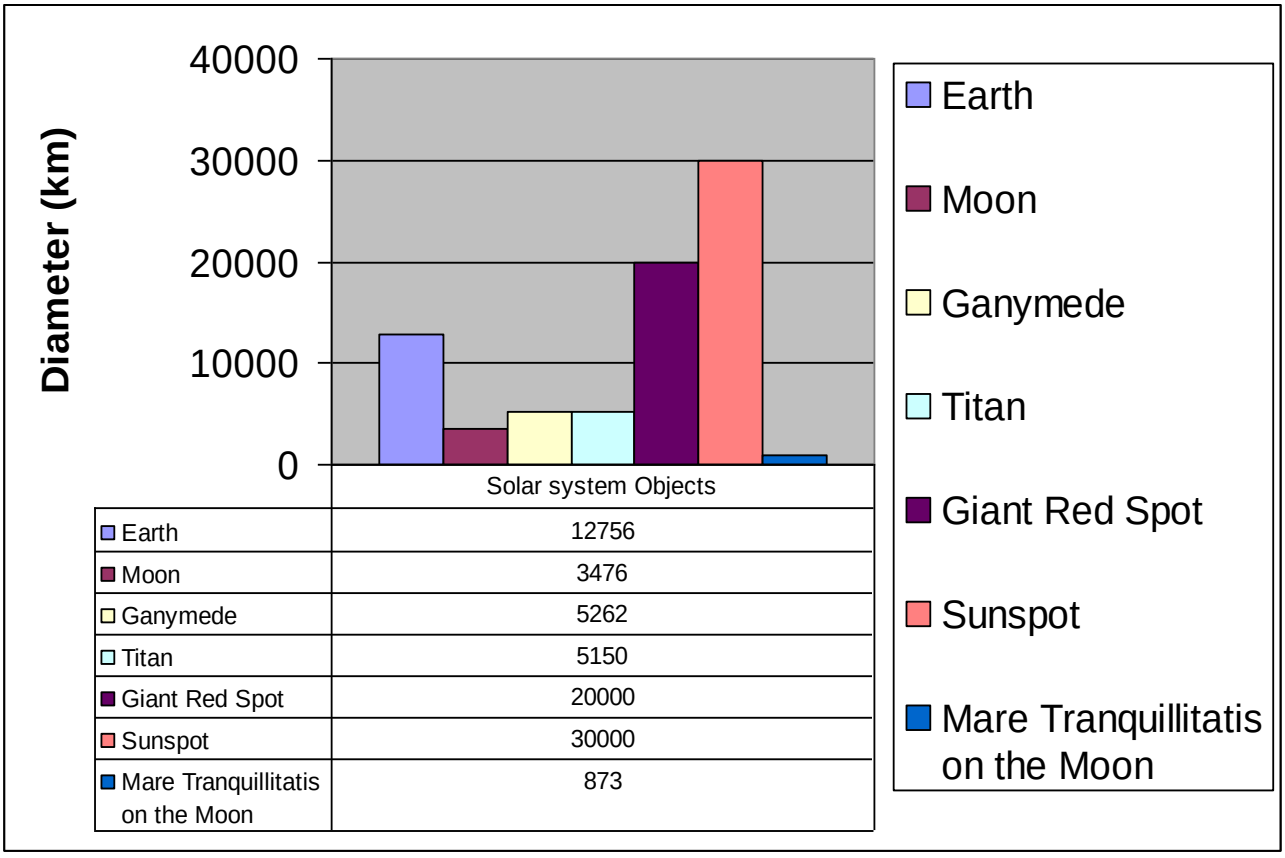


Diagram 2:
The diagram compares the objects of the Solar system with the Earth and the Moon. The measurements have been made in SalsaJ. For some objects we have written the approximately value.



Solar system Objects	
Earth	12756
Moon	3476
Ganymede	5262
Titan	5150
Giant Red Spot	20000
Sunspot	30000
Mare Tranquillitatis on the Moon	873

Diagram 3A:
This diagram shows the results of calculating the distances between the planets and the Sun using the Titius-bode rule.

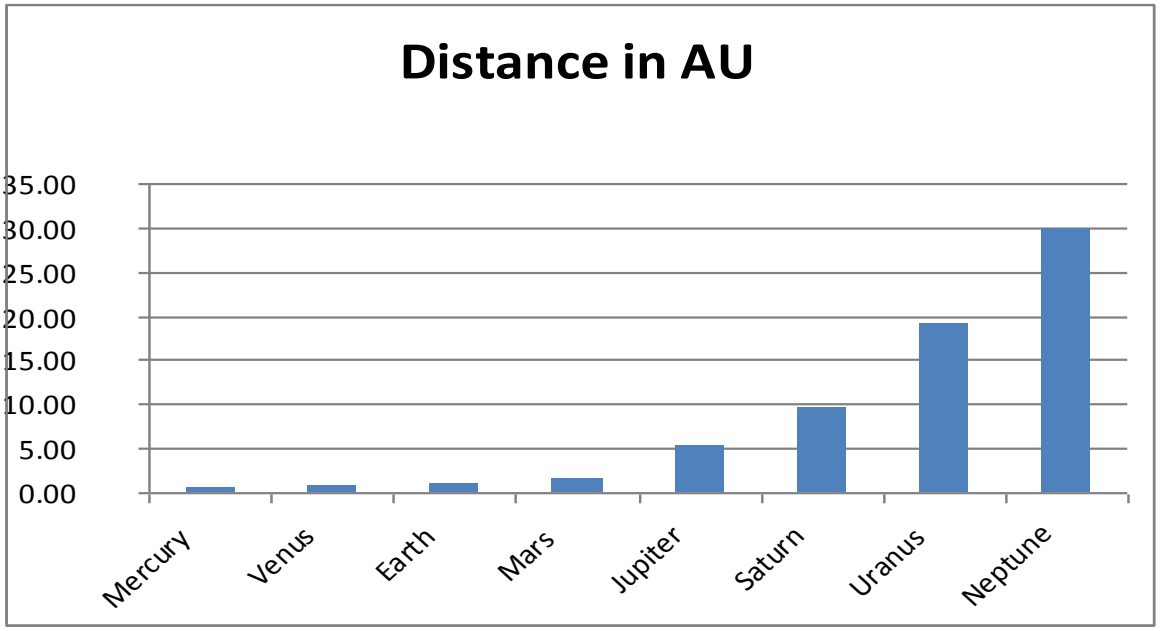
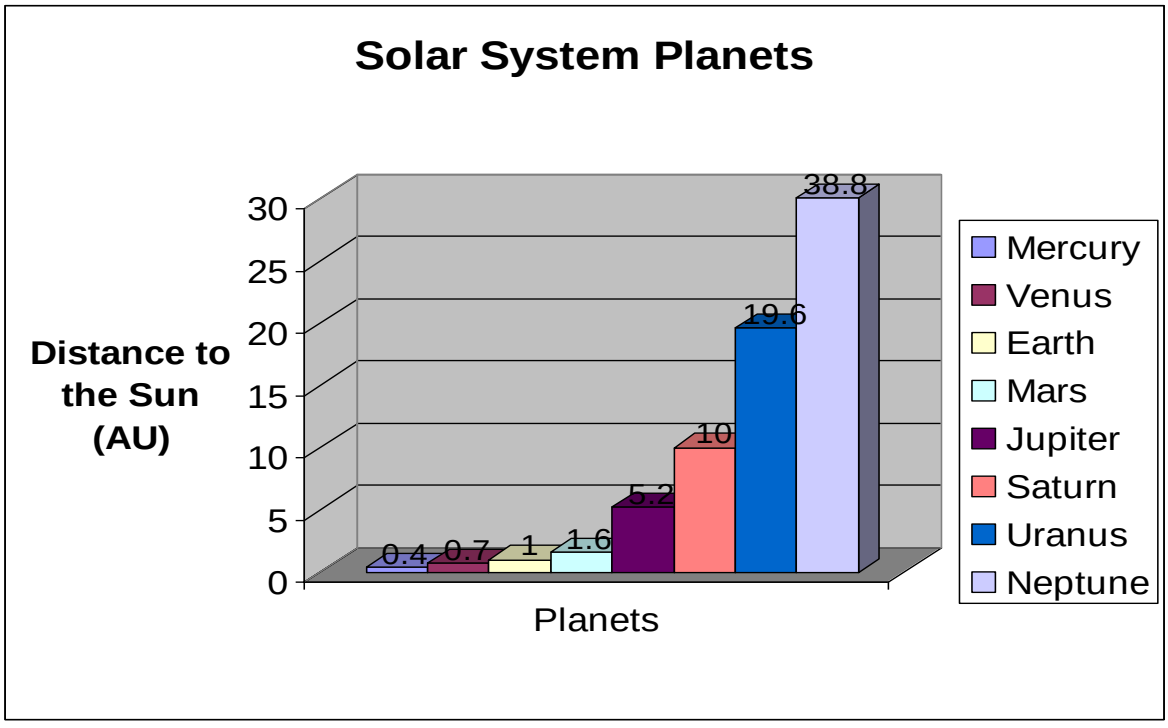
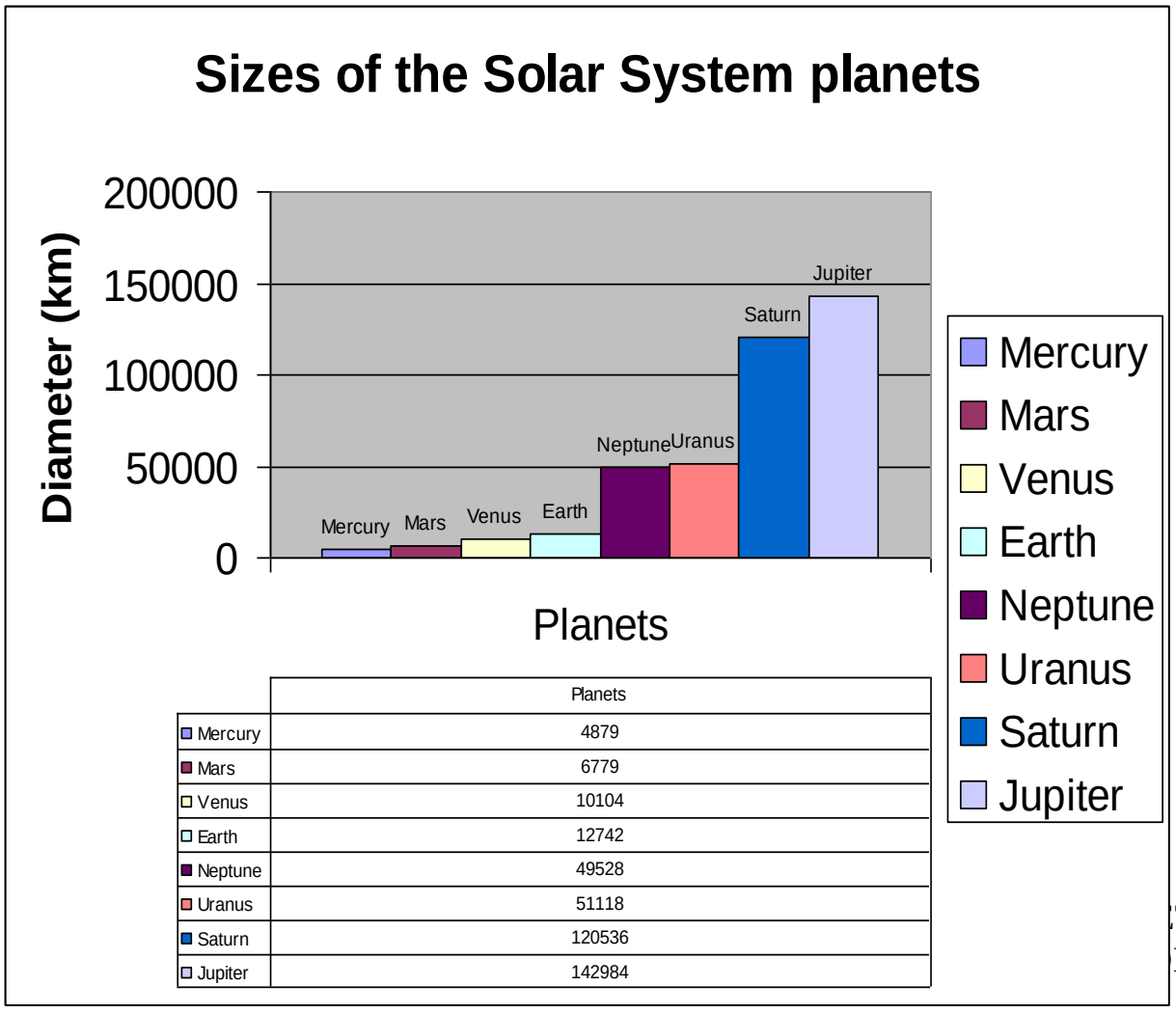


Diagram 3B:
This diagram shows the real distances.



Using the two diagrams we can say that the Titius-Bode rule can be used for calculating distances between planets and the Sun, but we have to know that it is not completely right.

Diagram 4:
The diagram compares the diameters of the Solar system planets.



	Planets
Mercury	4879
Mars	6779
Venus	10104
Earth	12742
Neptune	49528
Uranus	51118
Saturn	120536
Jupiter	142984

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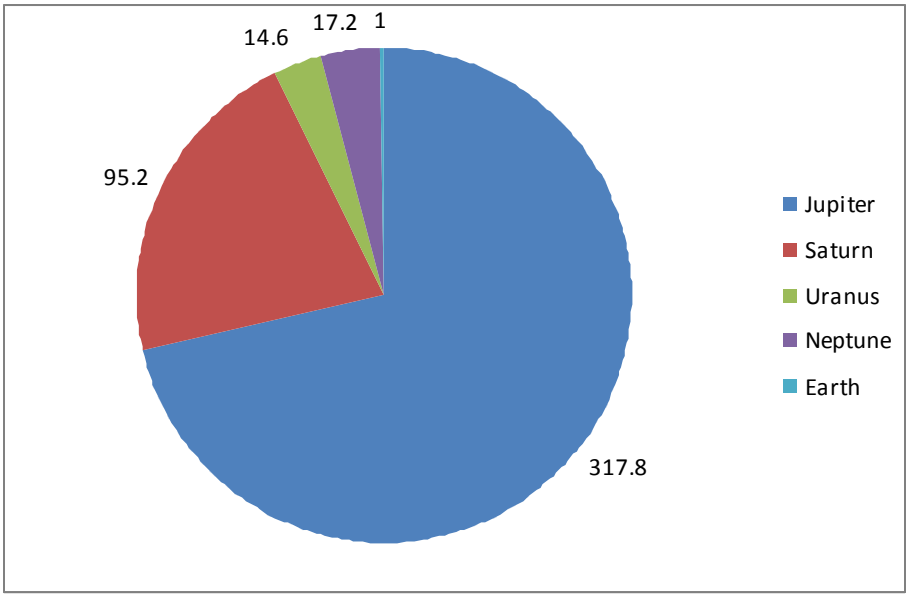
COMPARING THE GAS GIANT PLANETS FROM THE SOLAR SYSTEM WITH THE EARTH

FEATURES	JUPITER	SATURN	URANUS	NEPTUNE	EARTH
DIAMETER	11.209	9.449	4.007	3.883	1
MASS	317.8	95.2	14.6	17.2	1
RADIUS	5.2	9.54	19.22	30.06	1
ORBITAL PERIOD	11.86	29.46	84.01	164.8	1
PERIOD OF ROTATION	0.41	0.43	-0.72	0.67	1
ATMOSPHERE	H2, He	H2, He	H2, He	H2, He	N2, O2

http://solarsystem.nasa.gov/planets/[5]

The table shows other comparisons between some physical features of the gas giant planets and the Earth.

Diagram 5:
Comparison between mass:
We also made diagrams for easier showing the information:



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The diagram shows the mass of the giant planets compared with the Earth.

Diagram 6:
This diagram shows the orbital period of the giant planets compared with the Earth.

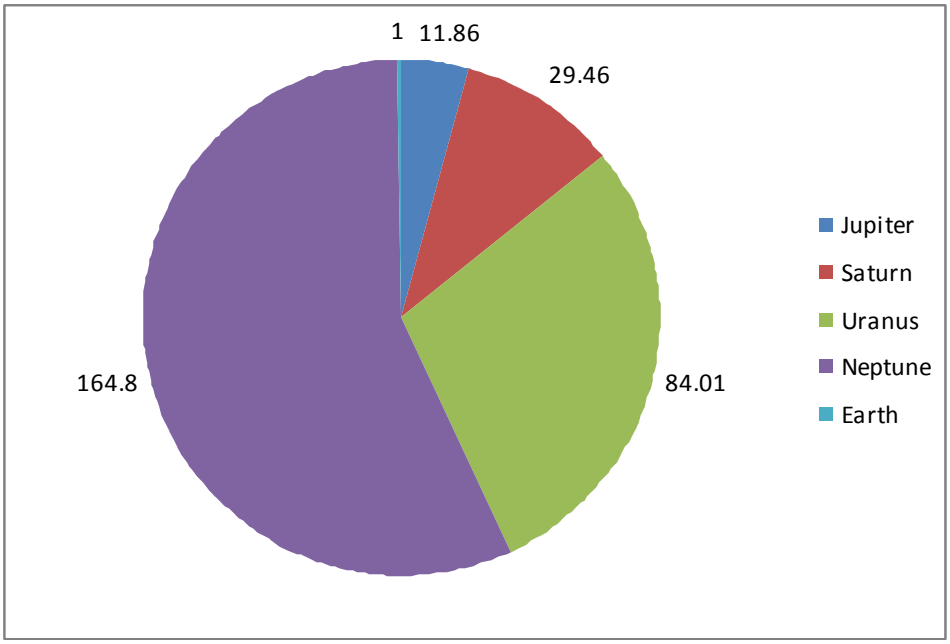
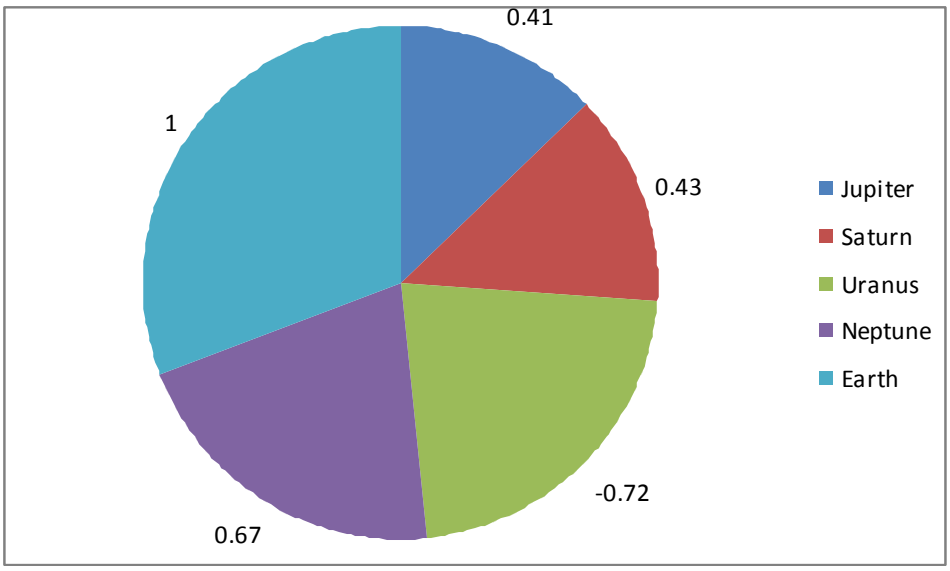


Diagram 7:
The diagram compares the period of rotation around the axis of the giant planets and the Earth.



6: We learned the programming system Scratch and we made a test about the Solar system with it. It has been uploaded on: http://scratch.mit.edu/projects/Tsetsa/3101794[6]

Conclusion of the project:

By working for this project we learnt:

- how to calculate the Wolf number and to see what is the sun activity;
- how to compare the sizes of the planets by using diagrams and we learnt more about their proportions;
- how to calculate the distance between the Sun and the planets using the Titius-Bode rule;
- more about the physical features of the Solar system planets;
- how to make animations such as rotation of the Sun;
- How to compare the size of the solar system through tables and graphical representation
- how to work with the Scratch software and how to use it for astronomical needs.

References:

1.http://www.euhou.net/index.php/salsaj-software-mainmenu-9

2. http://scratch.mit.edu/

3. http://900igr.net/prezentatsii/astronomija/Dostizhenija-astronomii/001-Malye-planety-Sootnoshenie-Titsiusa-Bode-1772-Bode-opublikoval.html

4. http://solarsystem.nasa.gov/planets/

5. http://900igr.net/prezentatsii/astronomija/Dostizhenija-astronomii/001-Malye-planety-Sootnoshenie-Titsiusa-Bode-1772-Bode-opublikoval.html

6. http://solarsystem.nasa.gov/planets/

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7. http://solarsystem.nasa.gov/planets/

8. "Great Atlas of the Universe" from Leopoldo Benakio