

Adapting high-tech into simple classroom activities

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Abstract

- Program of scientific research developed by secondary grade students exploring the facilities of the Educational Project **Telescópios na Escola (TnE)** – Telescopes in School at Universidade de São Paulo (USP).



- We use activities proposed by TnE
<http://www.telescopiosnaescola.pro.br/>

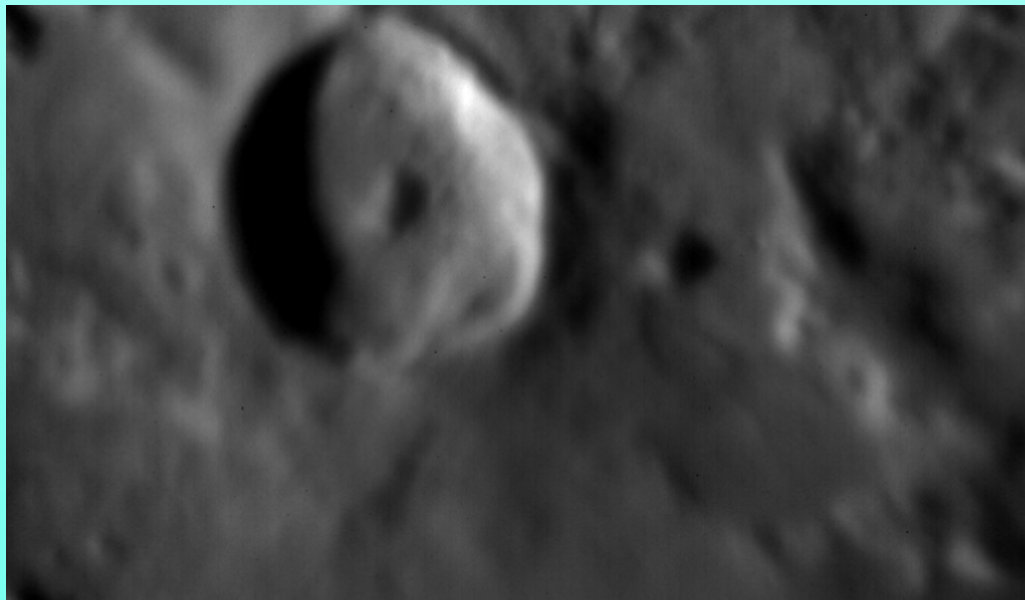
- Astronomical images as an attractive way to learn Mathematics and Physics.



1. We used a printed image of the Moon to measure the lunar craters.
2. Construction of a Galilean telescope with cheap material.

Measuring the size of Moon craters

- To explore: trigonometry, small angles and scale transformations.
- First step: find an Moon crater image in a database.
- Open the file using the Program DS9.



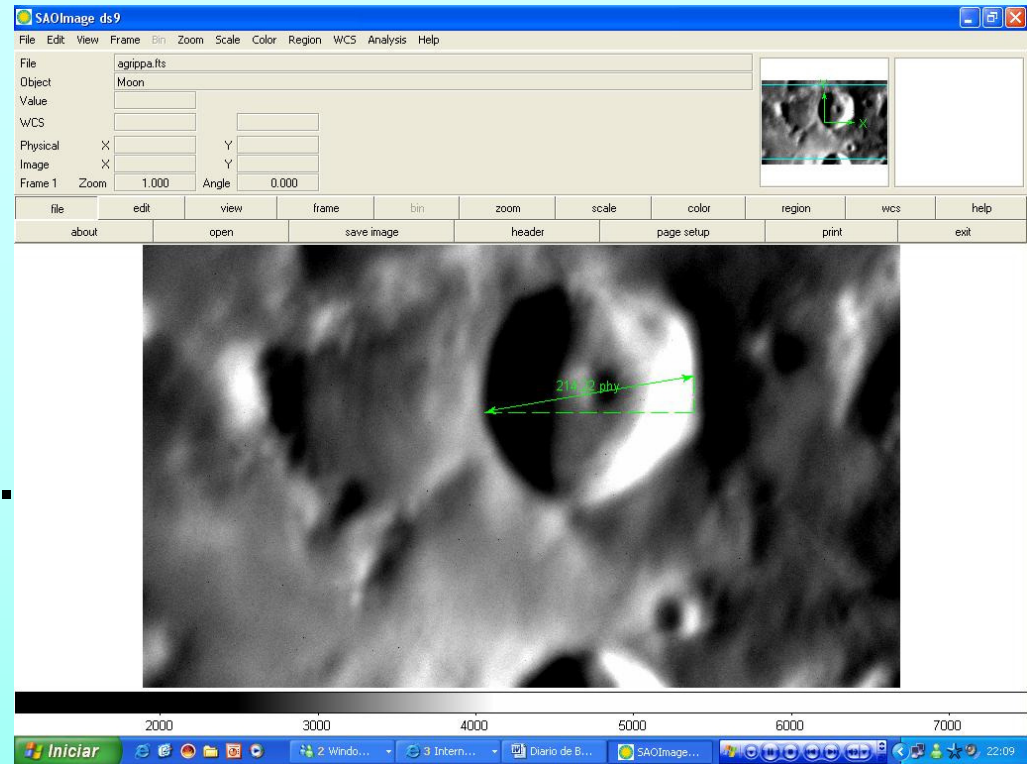
Agrippa crater

Lat: 4.1 °N

Long:10.5 °E

Depth : 3 km

- DS9 is a program to work with measurements of astronomical images.



Agrippa at DS9

- The tool used to measure the craters of the Moon was the ruler.
- 10 measures were taken and then an average was made in order to minimize the errors.

Conversions

To succeed in calculating the diameter of the crater in km we need the following conversions:

- 1 pixel of the image corresponds to 0.1"
- 1738.1 km (radius of the Moon) equals 932.1"

- With a cross multiply rule you can get the diameter of the crater. See the example for the Agrippa crater:

$$\begin{array}{rclcl}
 1 \text{ pixel} & \text{-----} & 0.1'' & & 1738.1 \text{ km} & \text{-----} & 932.1'' \\
 219.8 \text{ pixel} & \text{----} & x & & y & \text{-----} & 21.98'' \\
 & & x = 21.98'' & & & & y = 41 \text{ km}
 \end{array}$$

- Compare the values with those scientifically accepted that is 44 km.

And schools that do not have computer?

- You should print the image of the crater (in lan-house, for example) to measure it.
- Check the scale of the image (1 cm equals how many km in reality).
- Take 10 measurements with a common ruler and take the average.
- Make the conversion from cm to km.

History of the telescope

- 400 years ago Galileo Galilei demonstrated the importance of the telescope for observations of the sky.
- Galileo observed the craters of the Moon, the sunspots, the phases of Venus and the moons of Jupiter.
- 2009 was chosen by the ONU as the International Year of Astronomy.



THE UNIVERSE
YOURS TO DISCOVER

INTERNATIONAL YEAR OF
ASTRONOMY
2009

Construction of a telescope with low-cost material

- To observe the craters of the Moon 5 telescopes were built by pairs of secondary grade students.
- The following materials were used:
 - Two PVC pipes with different diameters;
 - Lens 2 degrees of positive and monocle of photography;
 - Tape;
 - Account - drops;
 - Bar and black cardstock;
 - Black spray paint.

Procedures

- The PVC pipes were cut, polished and painted with black spray paint to reduce internal reflections.
- A pipe was embedded in another.
- The lenses were positioned:
the objective (lens of eye) in tip of the higher barrel and ocular (monocle) in dropper with cap cut.



Results

- The results were very satisfactory.
- The telescopes were named based on the constellations:
Andromeda, Fenix and Draco;



and the Galilean moons of
Jupiter: Io and Callisto.



Conclusions



- Using activities proposed by the Project TnE, secondary grade students are motivated to learn science through astronomical images.
- We also show that the activities can be adapted to schools with few resources.
- Participants: secondary grade students of Colégio Patriarca da Independência, Vinhedo, SP.