The CESAR education initiative
Cooperation through Education in Science and Astronomy Research

Miguel Pérez-Ayúcar, M Breitfellner, M. Castillo
On behalf of the CESAR Team, EPSC2018, 20 Sep 2018
EDUCATION PROJECT CESAR

“The EUROPEAN SPACE AGENCY as a didactic resource”

cesar.esa.int

- Started: June 2012
- ESA & ISDEFE & INTA
- @ESAC (European Space Astronomy Center)
- Age range: Primary - Secondary – University
- To promote science and technology among students
RESOURCES IN THE CLASS
Using our observatories

SPACE SCIENCE EXPERIENCE
School visits to ESAC

SPECIAL EVENTS
Scientific expeditions, transits, eclipses, hangouts ..

TEACHERS COURSES
Teachers CTIF C. Madrid

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CESAR - RESOURCES

NIGHT TELESCOPE
50cm
Cebreros, Spain

SOLAR TELESCOPE
H-alpha, visible,
ESAC, Madrid

CUBESAT ground station
VHF, UHF
ESAC, Madrid

NIGHT TELESCOPE
30cm
Robledo de Chavela,
Spain

RADIO TELESCOPE
15m S-Band
ESAC, Madrid
CESAR Theatre, workshop and meeting rooms
CESAR @ ESAC (European Space Astronomy Center)

Control Room & Theatre

CUBESAT antenna

RADIO telescope

SOLAR observatory
CESAR – Remote Control
HELIOS (ESAC) – SOLAR OBSERVATORY
## HELIOS (ESAC) – SOLAR OBSERVATORY

### Sun in 2017

| H-alpha | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Jan     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Feb     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Mar     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Apr     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| May     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Jun     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Jul     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Aug     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Sep     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Oct     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Nov     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Dec     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

| Visible | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
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SPECIAL EVENTS
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Education Project CESAR

Lectures

The colour of the Stars - German School
4th year of Primary School - 36 students
See more

Travel through Solar System - CEIP El Pradillo de Ávila
70 students - 2º Primary
From Avila - Spain
See more

Javier Ventura & Topographic Study with Augmented Reality - Lycée Ibn
26 Students - CM2A
See more

Topographic Study with Augmented Reality - Jesús Maestro School
80 Students 2ºESO
See more

Solar Mass Ejections - J.L. López Aranguren school
3 ESO + 1 Bachillerato - 48 students
See more

Hertzsprung-Russell diagram - IES Francisco Giner de los Rios school
4 ESO - 50 students
See more

Topographic Study - IES Francisco Giner de los Rios school
110 students - 4th year of ESO
See more

Mission to the Moon - CRA Elena Fortún school
Third & Fourth year of primary school - 54 students
See more
Come and visit us and live an **unforgettable experience**.

<table>
<thead>
<tr>
<th>Space Science Experience Topic</th>
<th>Recommended age of the students</th>
<th>Introduction to the Scientific Case</th>
<th>Scientific Case</th>
<th>Recommended videos</th>
</tr>
</thead>
</table>
| Mission to the Moon           | 7-9                           | English                            | English         | • Introduction to ESA (6:46 min)  
                                |                               |                     | Map Material          | • Departure into Space (4:02 min)  |
|                               |                               |                                    |                 | • Paxi - The Solar System (5:18 min) |
| The colour of the stars       | 8-10                          | English                            | English         | • Introduction to ESA (6:46 min)  
                                |                               |                     |                 | • Departure into Space (4:02 min)  |
                                |                               |                                    |                 | • Further than the Solar System (6.03 min) |
| Topographic study             | 10-12                         | English                            | English         | • Introduction to ESA (6:46 min)  
                                | On Thursday is the Topographic Planetary Study with Augmented Reality |                     |                 | • Departure into Space (4:02 min)  |
                                |                               |                                    |                 | • The space missions that observe the Earth (5.11 min) 
                                |                               |                                    |                 | • Paxi - The Solar System (5.18 min) |
| The rotation of the Sun       | 12-14                         | English                            | English         | • Introduction to ESA (6:46 min)  
                                |                               |                     | Image1 Image2         | • Departure into Space (7.19 min)  |
                                |                               |                                    |                 | • Science@ESA: Episode 8: The Sun, our local star (24.20 min, recommended at least the first 5 min) 
                                |                               |                                    |                 | • Paxi - Day, night and the seasons |
| Solar mass ejections          | 14-16                         | English                            | English         | • Introduction to ESA (6:46 min)  
                                |                               |                     |                 | • Departure into Space (7.19 min)  |
                                |                               |                                    |                 | • Science@ESA: Episode 8: The Sun, our local star (24.20 min, recommended at least the first 5 min) |
The CESAR Science Cases deal with many different topics, all of them didactic and suitable for involving students in a science experience. A given Science Case is offered in different levels, so that teachers can pick the one more appropriate to their students’ background of Mathematics and Physics. Note that not all Science Cases are available for all levels; pay attention at the level indicator and read the corresponding Teacher’s Guide for further information.

**Basic**
Fundamental knowledge of the Universe at one-click distance! Without formulae or complicated Math, simple as it is.

**Intermediate**
Basic Physics crafting the Cosmos! The next step to expand your knowledge of our Universe with some basic concept and formulae.

**Advanced**
Go one step forward! Put all your knowledge of Physics and Math to use. Skip no detail, and experience the Universe from end to end.

**Super Hero**
The real pro-level! Science as it is. Advanced Physics, high-level Math, and programming. Use every tool available to reveal the mysteries of the Universe.

Credits: Nautilus
SCIENCE CASES at ESAC
Science Experience stats

GENERAL STATS (SINCE OCTOBER 2016)

Total schools in database: 134
Total teachers in database: 202
Total students in SSE visits: 5498
Total sessions in SSE visits: 129

SPACE SCIENCE EXPERIENCE 2018

Total students: 3001
Total schools: 47
Total teachers: 57 registered - 182 total in ESAC lectures
Total sessions: 67
Students per session (average): 44.8
Teachers per session (average): 2.7

AGES

<table>
<thead>
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<th>Age</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>06-07 years</td>
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<tr>
<td>07-08 years</td>
<td>6</td>
</tr>
<tr>
<td>08-09 years</td>
<td>12</td>
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<tr>
<td>09-10 years</td>
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<td>16-17 years</td>
<td>11</td>
</tr>
<tr>
<td>17-18 years</td>
<td>5</td>
</tr>
</tbody>
</table>
SCIENCE experience: university
SCIENCE experience: general ESAC visits
SCIENCE experience: special events at school

ERATÓSTHENES

MEDIDA DEL DIÁMETRO DE LA TIERRA
SCIENCE experience: student work experience

- Join ESA scientists and engineers during three days to get an insight into their daily work

- Just before their University year

- 3 days per year, 15-16 years old ~ 40 students
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Education Project CESAR

TEACHERS COURSES

Organized officially in collaboration with Comunidad Madrid

400+ teachers 2017-2018

4 days – 3h

Every ~3 months
Next Teacher Courses …

24-27 Sep 2018
¿How to use a telescope in the school?

15-18 Oct 2018
Our inner Solar System: Mercury and BepiColombo, Venus and Venus-Express, Mars and Mars-Express y ExoMars

11-14 Feb 2019
Our outer Solar System:
Jupiter and JUICE, Saturn and Cassini-Huygens,
Comets and Rosetta

22-25 Apr 2019
Space Astronomy
Explora el Universo con tu clase
Curso para profesores
13 - 15 Junio 2018

Dr. Michel Breitfellner, Dra. Beatriz González, Angel del Pino

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Scientific expeditions are organized to engage students with rare exotic events

- Super rare: Venus transits (not anymore in our lifetime)
- Mildly Rare: Mercury transits
- Normal Rare BUT AWE: solar and lunar eclipses
EXPEDITIONS EVENTS – main parts (1/2)

(1) Interactive LIVE transmission:
- Live images via ESAC servers in the web
- LIVE hangout with presentations from experts and LIVE connections to expeditions
(2) Creation of Offline Science Cases for students
EPSC 2012: Venus Transit movie shows perspective in viewing our Solar System
Blood Moon, 27 July 2018
COLLABORATION

- Promote **ESA** science **satellite** projects
  - Venus Express, Solar Orbiter,
    Proba 2 – Proba 3, Bepi Colombo, Gaia …

- **ESA communications**
  - ESAC Comms – Intranet, Press
  - ESA Science Comms – ESA main portal, ESA TV, Science Image of the Week

- Support from **local hosts**
  - ESO, Paranal
  - NASA Canberra Deep Space Network
  - Izana Observatory Teide, Canary Islands
  - Casper University

- **Education** with
  - ESA Education Office – ESTEC (science cases)
KEY POINTS

- CESAR-ESA Educational project offers **didactic material** based on own observatories and ESA Science resources, from primary to University grades.

- CESAR controls small **observatories** to directly use and obtain data
  - Optical telescopes x2
  - Solar telescopes x2
  - Radio telescope
  - Cubesat ground station

- **Education** activities are
  - School Science Experience
  - University
  - Teacher courses
  - ESAC general visits

- **Special Events** are organized to engage students with **rare astronomical events**: Venus and Mercury transits, solar and lunar eclipses