



InSight



SEIS

JPL

cnes



DLR

ETH

LOCKHEED MARTIN



saab

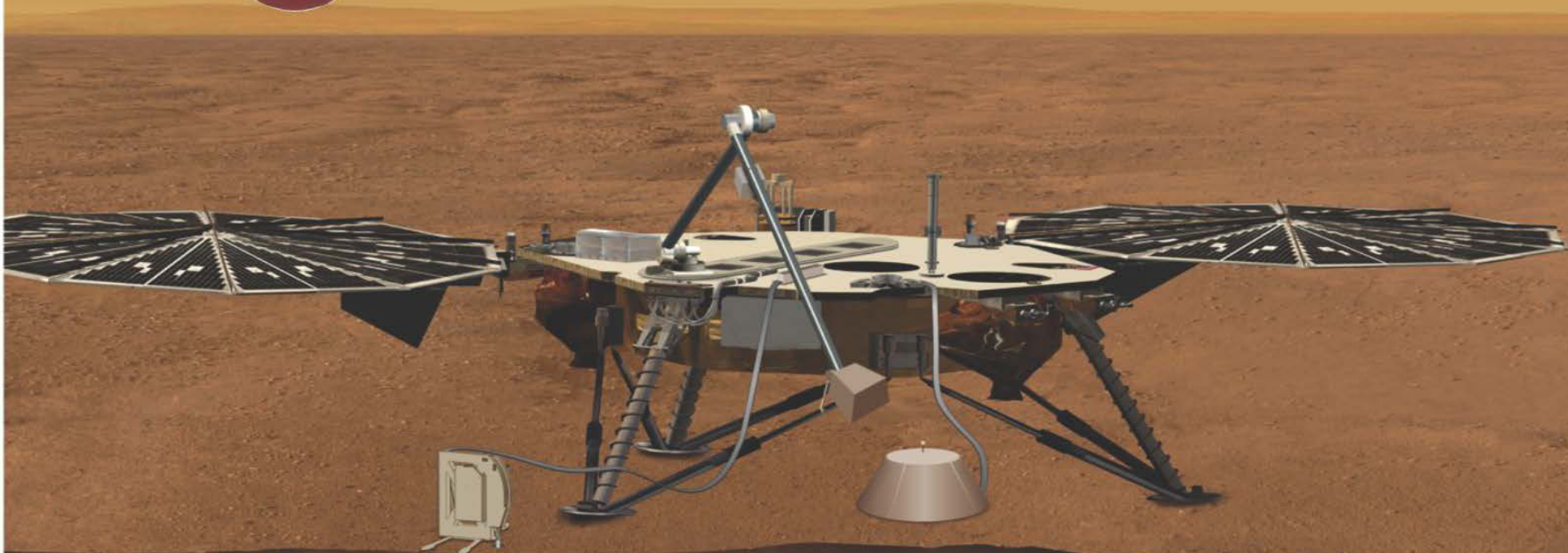


Imperial College London



Education & Outreach

Tuned in to Mars ... from the schools



TIME REMAINING

DAYS	HOURS	MINUTES	SECONDS
363	00	00	00

Jean-Luc Berenguer
Géoazur – University Côte d'Azur

Paris, IPG,
November 28, 2017



Tuned in to INSIGHT mission ... from the schools

Education Plan Implementation for SEIS INSIGHT mission

A unique opportunity to develop a specific scientific programme for schools and general public !

> To follow, in live, seismic activity of another terrestrial planet !

> To discover and to study planets at school with a less virtual approach.

> To test hypotheses through fun hands-on experiments and directly inspired by the mission.

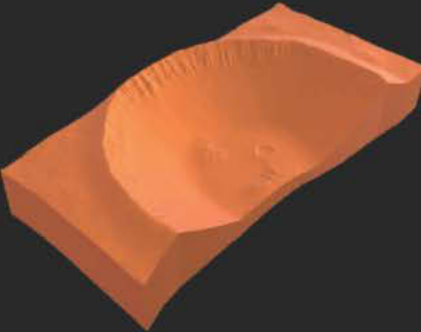


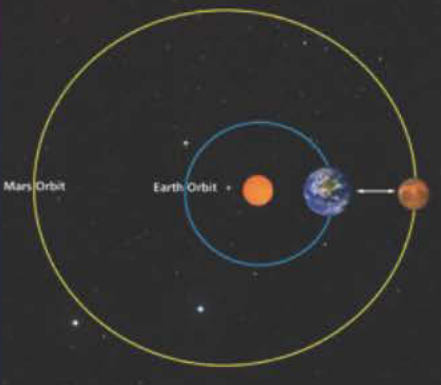

> To organize workshops for teachers to explore some innovative activities in geophysics.



Bring SEIS INSIGHT mission into the classroom

... A thematic distribution of resources



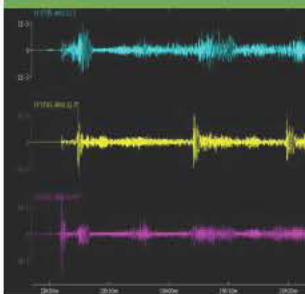
<p>Topic 'DATA' On-line published data for schools</p>		<p>Topic 'JOURNEY' The travel from Earth to Mars</p>		<p>Topic 'SIGNAL' The technical aspects of the data transmission</p>
	<p>Topic 'TELLURIC' Hands-on activities about planetology</p>		<p>Topic 'SENSOR' The instrumentation in relation with the planet environment</p>	



Topic 'DATA'

On-line published data for schools

Topic 'DATA'
On-line published
data for schools



Display data at school from Mars
Access to data selected for educational use
(Mars ... but also Moon)
Case studies packages for teachers to investigate
Mars planet

and more ...

Topic 'JOURNEY'

The travel from Earth to mars

Topic 'SENSOR'

The instrumentation in relation
with the planet environment

Topic 'SIGNAL'

The technical aspects of the data transmission

Topic 'TELLURIC'

Hands-on activities about planetology

Let's see some examples >

Topic 'DATA' :

On-line published data for schools





Topic 'DATA'
On-line published
data for schools

For students



Hundred of Schools will receive SEIS and weather data from Mars daily...

InSight/SEIS will develop its Education Program through partnership with the already existing SEISMO at school networks :

-  SISMOS à l'École (FR, OCA)
-  Seismometers in schools (US, IRIS)
-  Seismology at School (CH, ETHZ)
-  School seismology (UK, BGS)

Other are welcome ...

Topic 'DATA' :
On-line published data for schools

Topic 'DATA'
On-line published
data for schools

EduCarte v3.3.0X18 - TOPO/LRO_LOLA/quadtree_6 © A.Lomax & J.L Berenguer

Fichier Langue

Version Impri: Position du Curseur: Lat= 42,58° Lon= 154,23° Elev= 0m Navigation: Alt - Activer, Ctrl - Zoom

For students

Afficher Tous
Effacer Tous

SIVB508
SIVB509
SIVB510
SIVB511
SIVB512

seisme

Fichier Affichage Outils Aide

Initialie Précédente

Pointer... Filtrer... Unités Amplitude Spectrum Spectrogram

X Pointer: P S Lr Lr2 Lr3 Autre Supp Tous

0 2000 4000 6000 8000 10000 km -9124 0 10775 m

Saisie d'un point: Calcul d'une distance Grille de distances Tracer des cercles Tracer des médiatrices Bloc diagramme 3D Saisie d'une vitesse

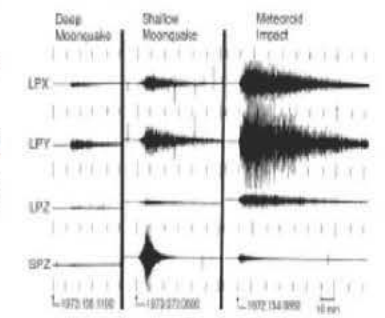
Aide Saisie d'un point: Lat: 5,83 ° Lon: 136,77 ° Prof: -0,00 km Etiquette: Repère Couleur Afficher Effacer Tous



Moon Data (Apollo missions)

- Calculate speed waves with data from NASA Apollo missions
- Locate SIVB impact
- Seismograms topology on the Moon
- ...

Representative lunar seismograms taken from the Apollo 16 mission. (Nakamura et al, 1974 and 1982)
LPX, LPY, and LPZ = 3 orthogonal components of a long-period instrument.
SPZ = short-period vertical component. A typical thermal moonquake (not shown) would appear as a signal of very short duration only on SPZ.

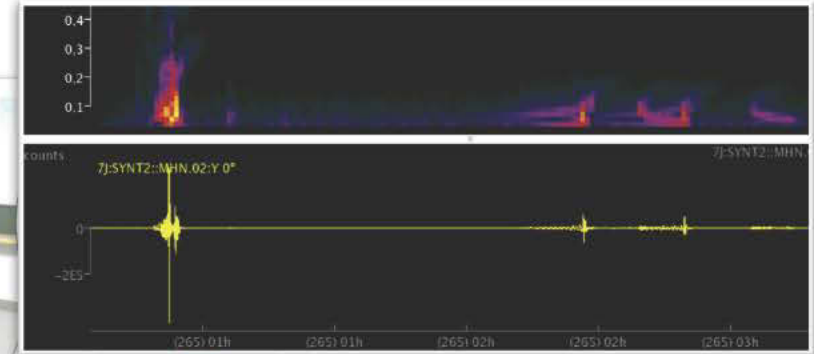
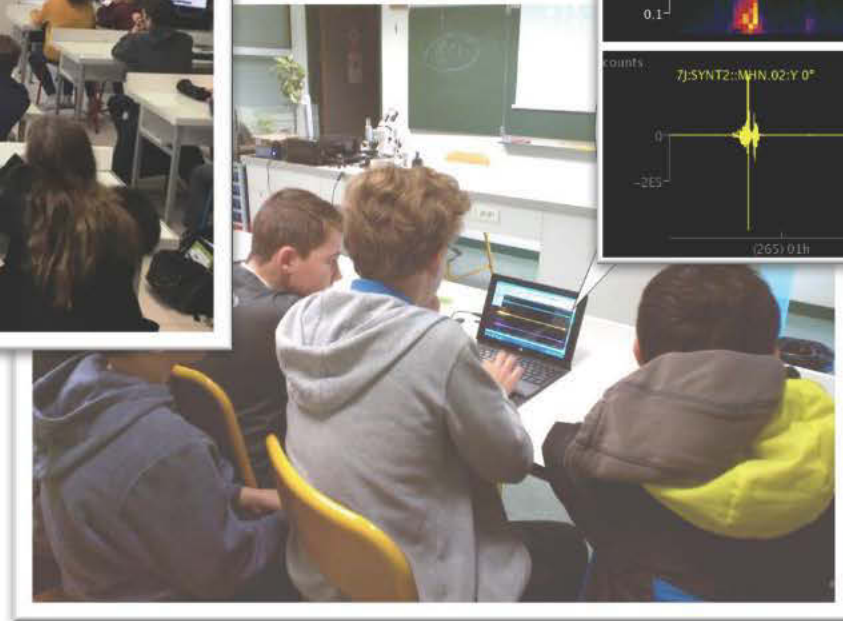
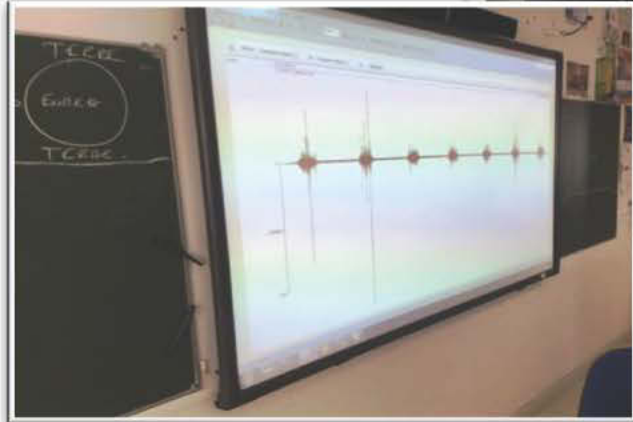


Topic 'DATA' : On-line published data for schools

French schools have applied to the Blind test for SEIS InSight
15 schools participate to the blind test ! (Oct. 2017 > Jan. 2018)
One school > one month of data !

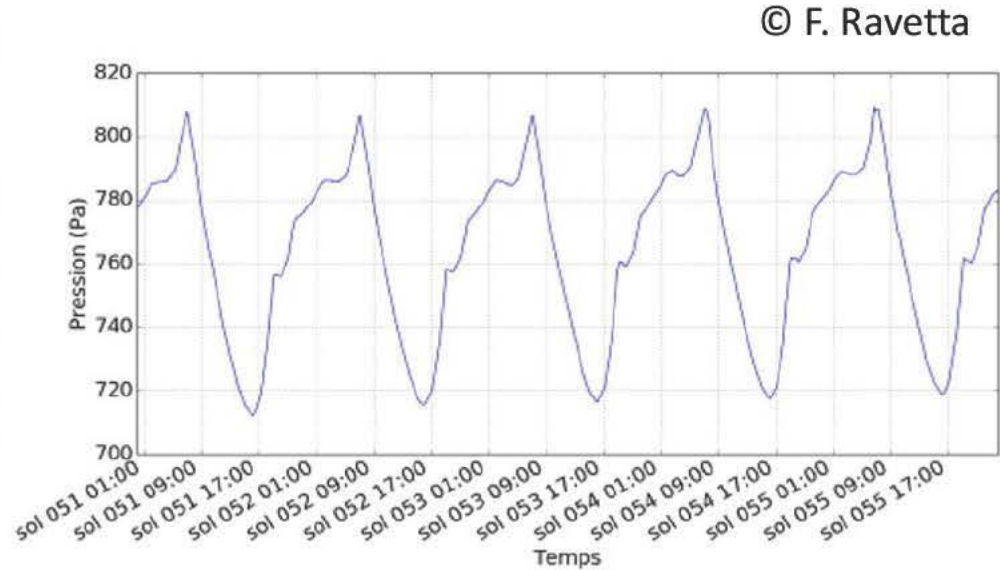


November 2017



Topic 'DATA' :

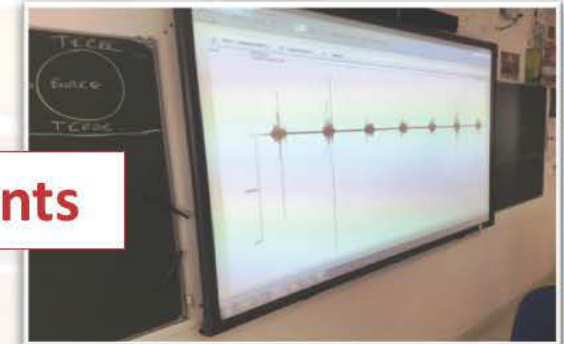
On-line published data for schools



Atmospheric pressure - Curiosity rover – Sol 51 to 55

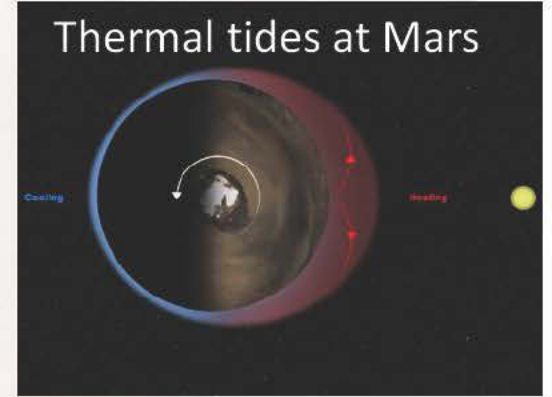


For students



- Seasons on the Earth and on Mars ?
- Temperature and Pressure variations ?
- ...

Earth weather data from :
METEO à l'Ecole
<http://www.meteoalecole.org/>
Mars weather data from :
REMS (Curiosity, InSight)
<http://cab.inta-csic.es/remc>





Topic 'TELLURIC'

Hands-on activities about planetology



Topic 'TELLURIC'
Hands-on activities
about planetology

Seismology experiments

Meteorites craters impacts

Physical states of water, pressure and temperature

and more... erosion, gravity, density

Topic 'DATA' :

On-line published data for schools

Topic 'JOURNEY'

The travel from Earth to mars

Topic 'SENSOR'

The instrumentation in relation
with the planet environment

Topic 'SIGNAL'

The technical aspects of the data transmission

Let's see some examples >

Topic 'TELLURIC'

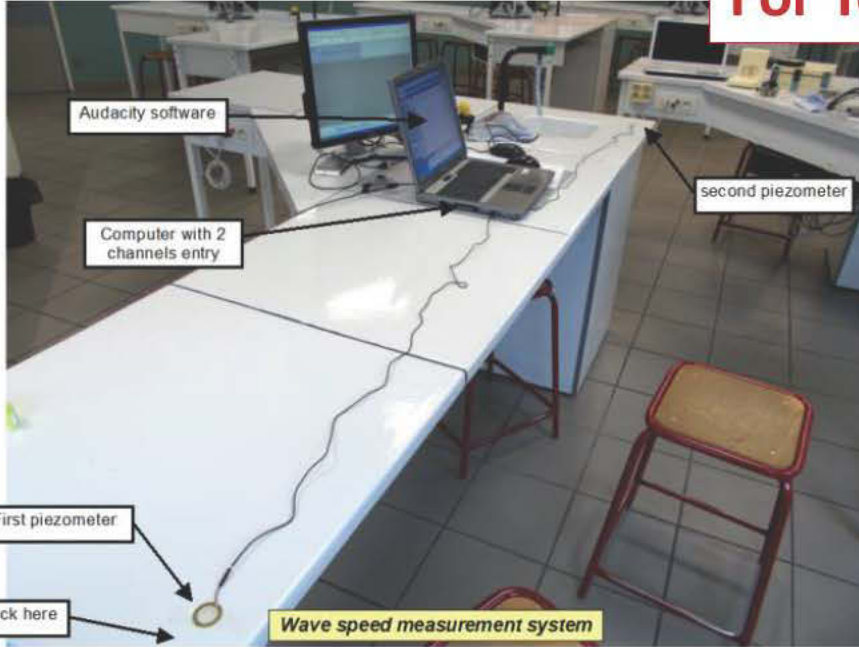
Hands-on activities about planetology



Topic 'TELLURIC'
Hands-on activities
about planetology

For Teens

The seismobox 'Do it yourself'



- Calculate waves speed / various material
- Record earthquake with piezoelectric cells
- Calculate waves speed / various material
- Locate epicenter
- Seismic cycle

Interface

Arrival time written on the white-board

synchronisation thread

Microphones set on the ground (Geophones)

Simulation of a micro-earthquake

Experimental assembly

Traces recorded with 3 different microphones

The goal is to understand how to locate an earthquake when we know neither the location nor the speed. (Chock with a hammer)

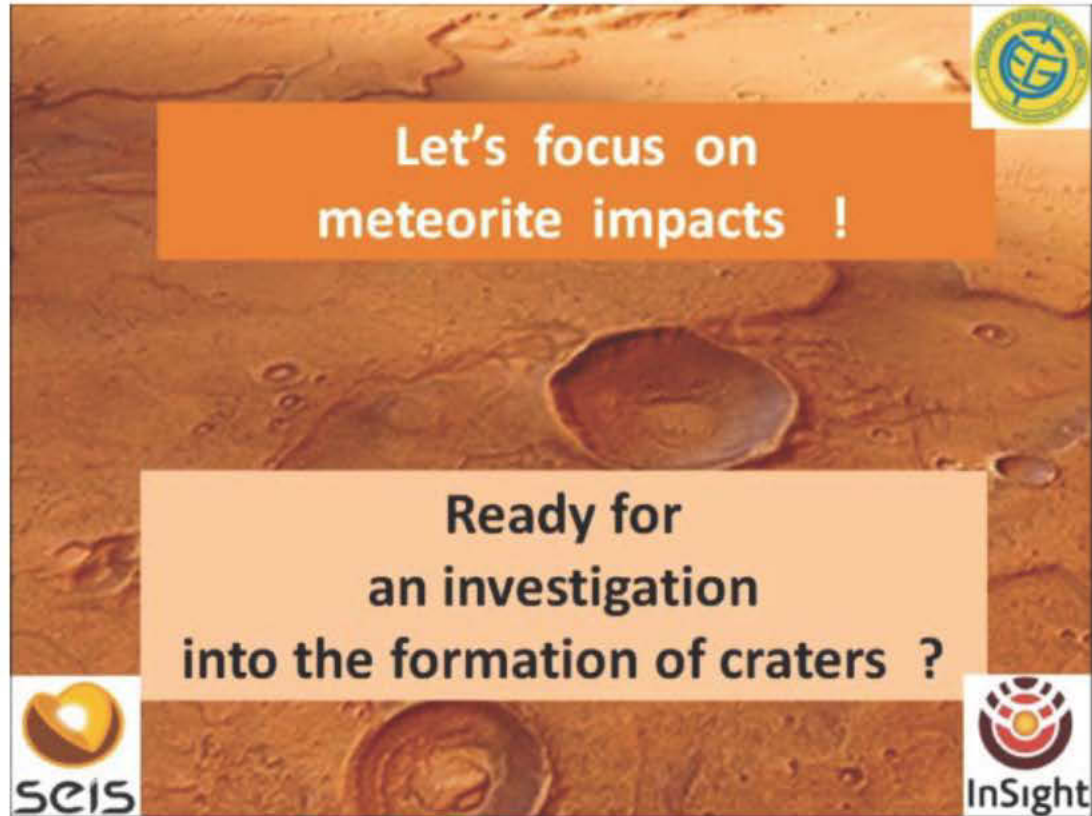
Student discover the necessity to synchronize the acquisition system (normally with GPS).

Topic 'TELLURIC'

Hands-on activities about planetology






Topic 'TELLURIC'
Hands-on activities
about planetology

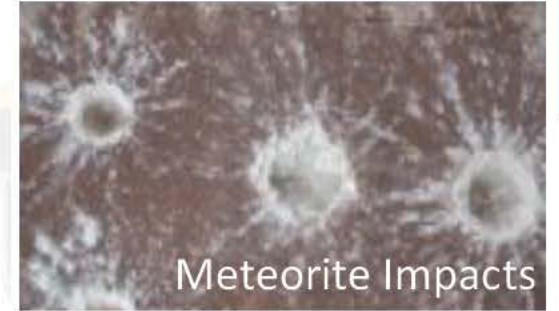


Let's focus on
meteorite impacts !

Ready for
an investigation
into the formation of craters ?



© D. Carrer



For Teens

How to build yourself?



- Investigation
- Impact / energy
- Moon, Mars topography
- ...

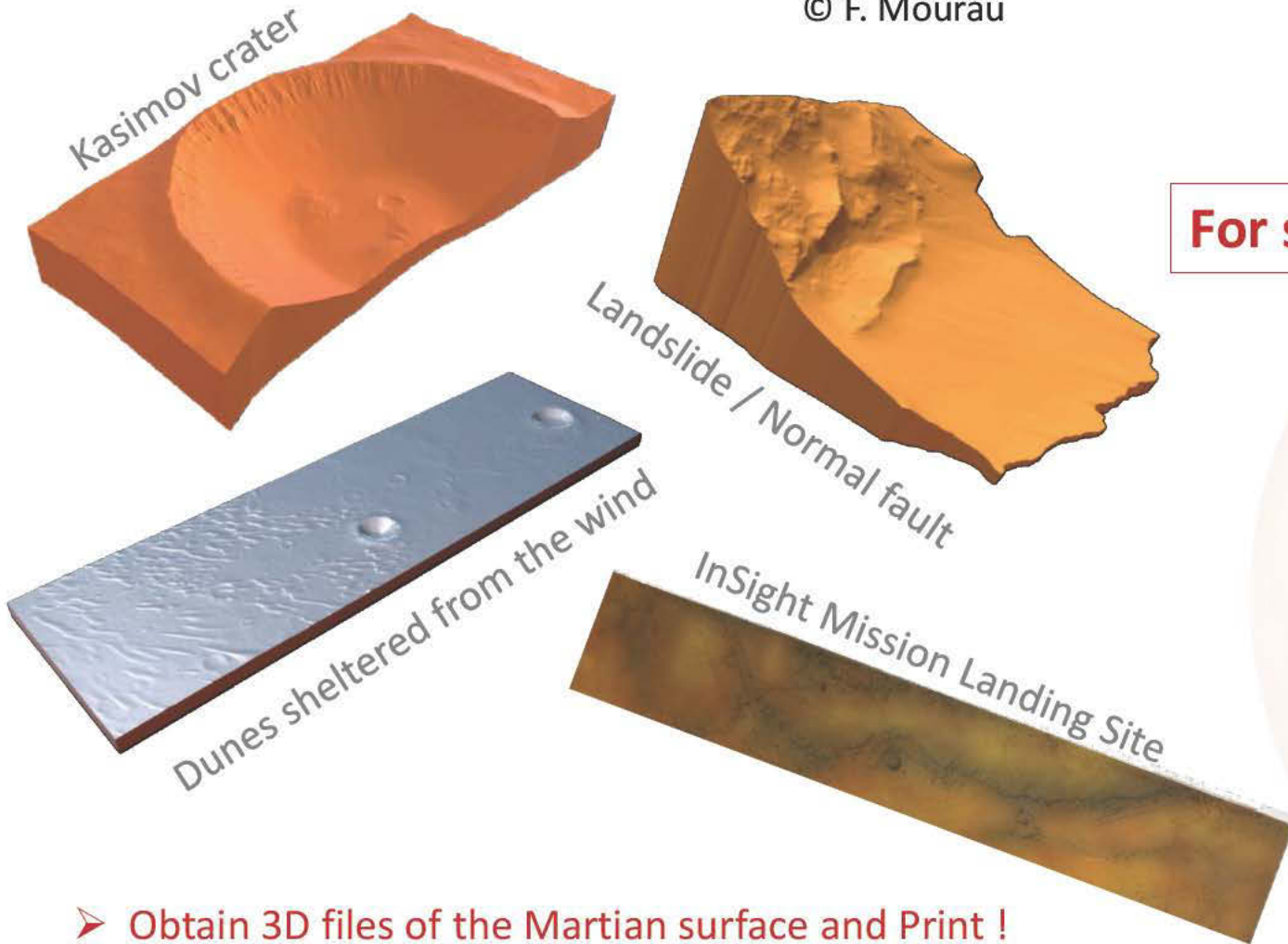
Topic 'TELLURIC'

Hands-on activities about planetology



Topic 'TELLURIC'
Hands-on activities
about planetology

© F. Mourau



Martian surface

For students

➤ Design a dust devil model



Dust devil

© W. Fortin

➤ Obtain 3D files of the Martian surface and Print !
Thanks to the camera HiRISE



Topic 'JOURNEY'

The travel from Earth to Mars

Topic 'JOURNEY'
The travel from Earth
to Mars



Escape from the Earth
Solar system, distances, scales, planets position
Landing on Mars

and more ...

Topic 'SENSOR'

The instrumentation in relation
with the planet environment

Topic 'TELLURIC'

Hands-on activities about planetology

Topic 'DATA' :

On-line published data for schools

Topic 'SIGNAL'

The technical aspects of the data transmission

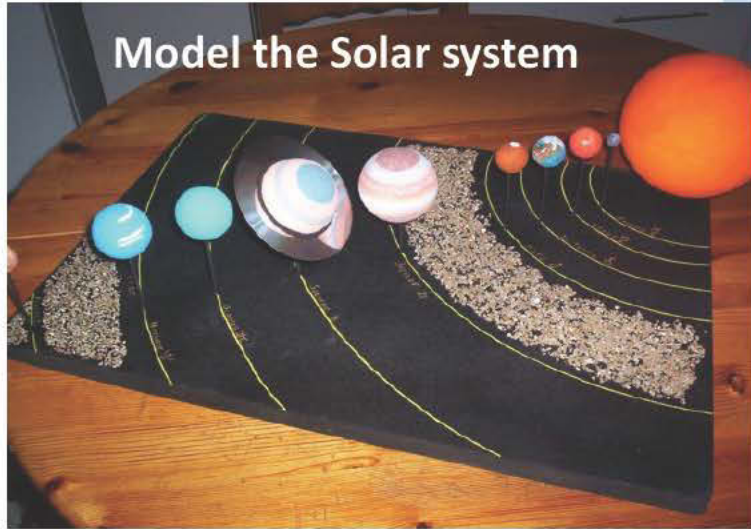
Let's see some examples >

Topic 'JOURNEY'

The travel from Earth to Mars

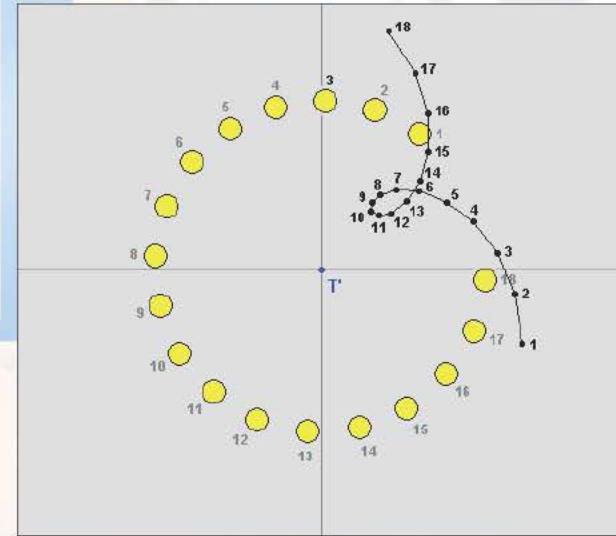
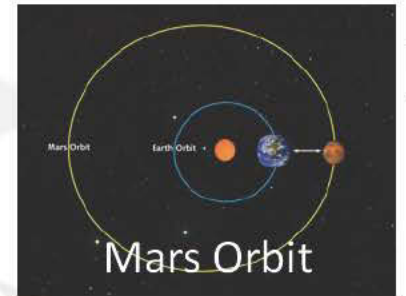
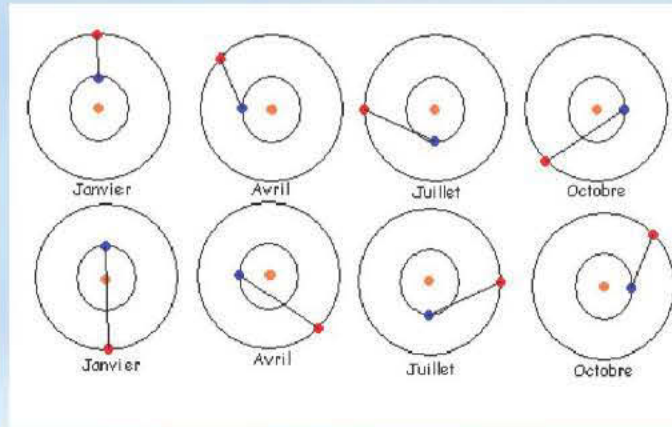
© F. Mourau / D. Guicheteau

For Teens



Model the Solar system

Where is Mars ?



Trajectories of Mars and the Sun in the geocentric reference table

- Where is Mars ?
- How far is Mars from us ?
- Mars' orbit characteristics
- ...



Topic 'JOURNEY'

The travel from Earth to Mars

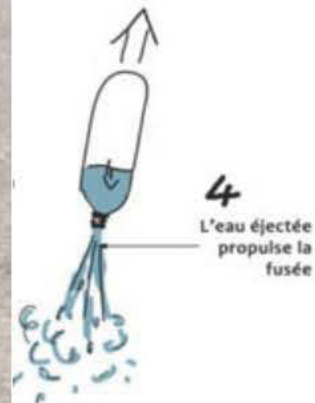
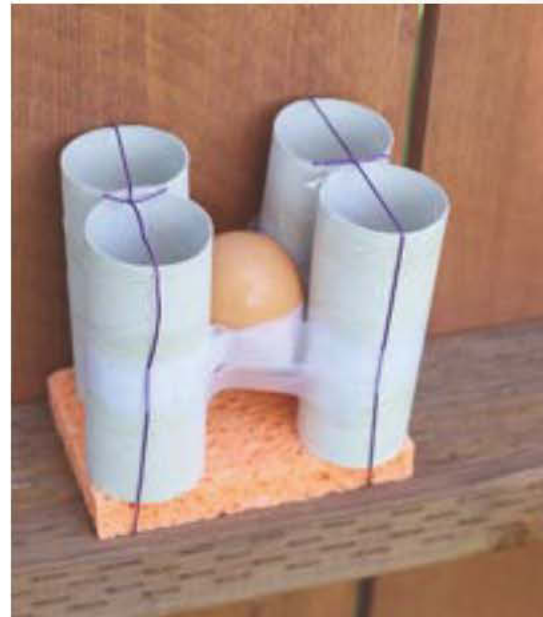


For Teens

Egg drop

Rockets

- Leaving the Earth, Landing on Mars
- The best moment to travel to Mars ?
- How to choose the landing site ?
- ...



Topic 'JOURNEY'

The travel from Earth to Mars



EarthMars v. 1.0

© J. Camponovo

```
precedent. [REDACTED]

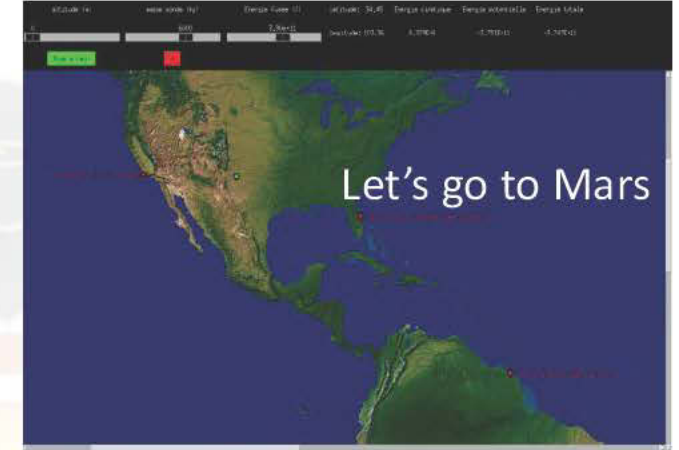
Bienvenue sur Mars!!

Vous avez utilise une fusée de 483 tonnes
pour quitter la Terre

Il vous a fallu environ 2935 kg de carburant
pour modifier votre vitesse à l'approche de mars

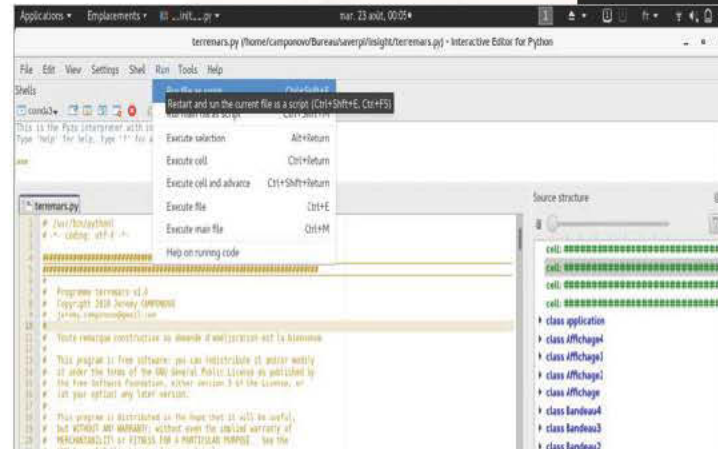
Vous avez réussi à apporter 3064 kg de materiel
```

For Teens



How to play ?

- Software 'serious game' to learn
- ... how to leave the Earth
- ... Travel to Mars





Topic 'SENSOR'

The instrumentation in relation with the planet environment



Topic 'SENSOR'
The instrumentation
in relation with the
planet environment

**Replica of the lander : Elysium, SEIS mascot,
Record seismic waves, wind, temperature, pressure
with simple sensors**

Test a seismometer with different environments

and more ...

Topic 'JOURNEY'

The travel from Earth to mars

Topic 'TELLURIC'

Hands-on activities about planetology

Topic 'DATA' :

On-line published data for schools

Topic 'SIGNAL'

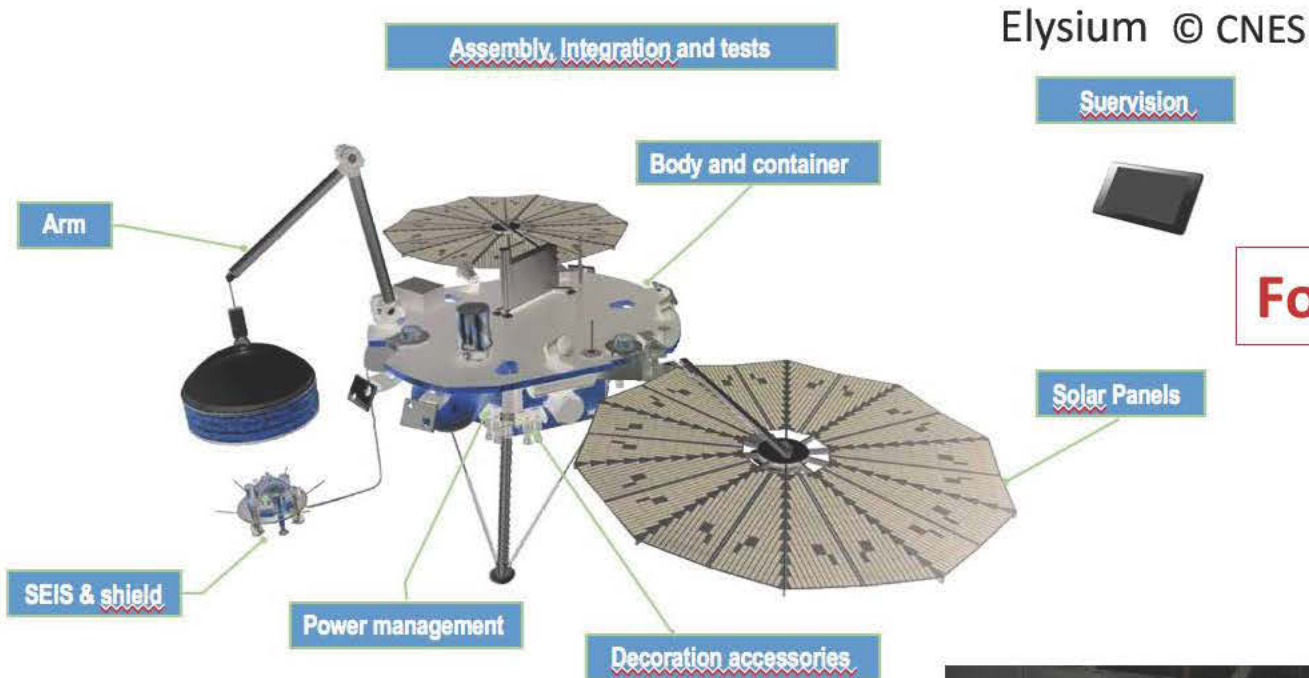
The technical aspects of the data transmission

Let's see some examples >

Topic 'SENSOR'

The instrumentation in relation with the planet environment

Topic 'SENSOR'
The instrumentation
in relation with the
planet environment



For students



- Elysium, a replica of the lander made by students from High schools of Toulouse
- Science expo (ex : Le Bourget, science Fair week)

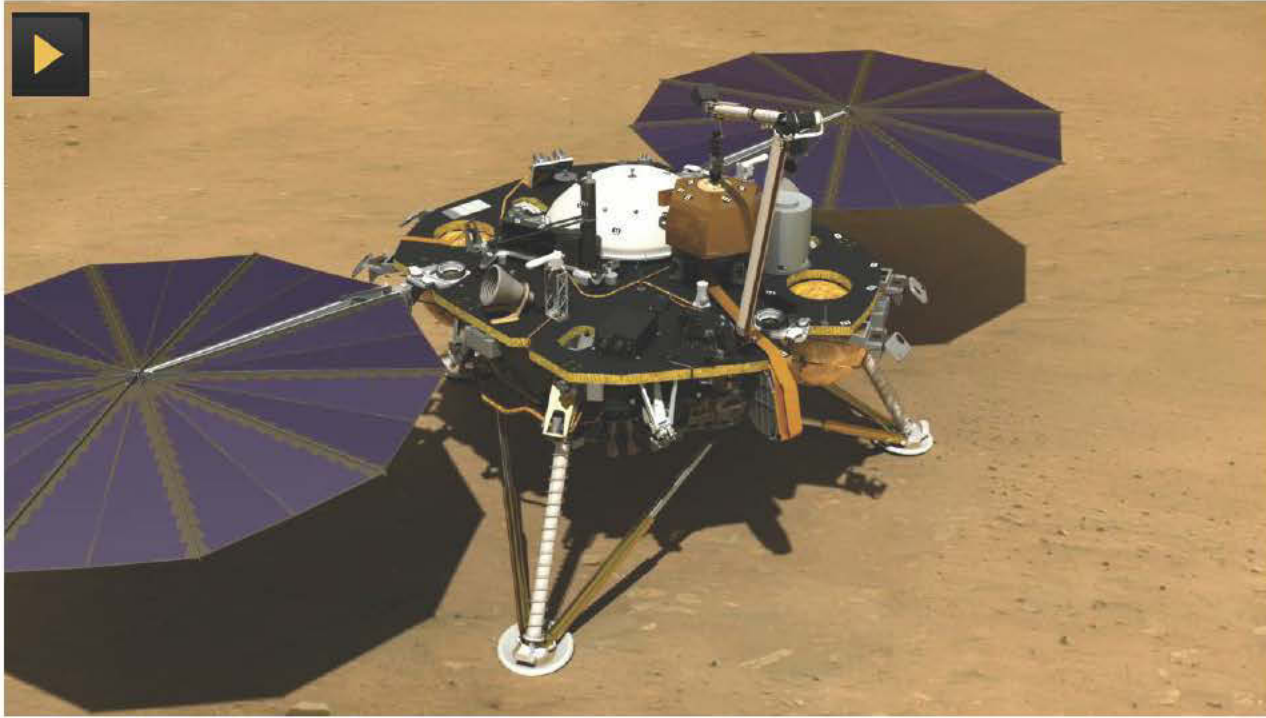


Topic 'SENSOR'

The instrumentation in relation with the planet environment



Topic 'SENSOR'
The instrumentation
in relation with the
planet environment



For students

- Create models for sensors
- Robotics, electronics, computing
- Models become mascots for the students !



© W. Fortin



© J. Camponovo



© W. Fortin

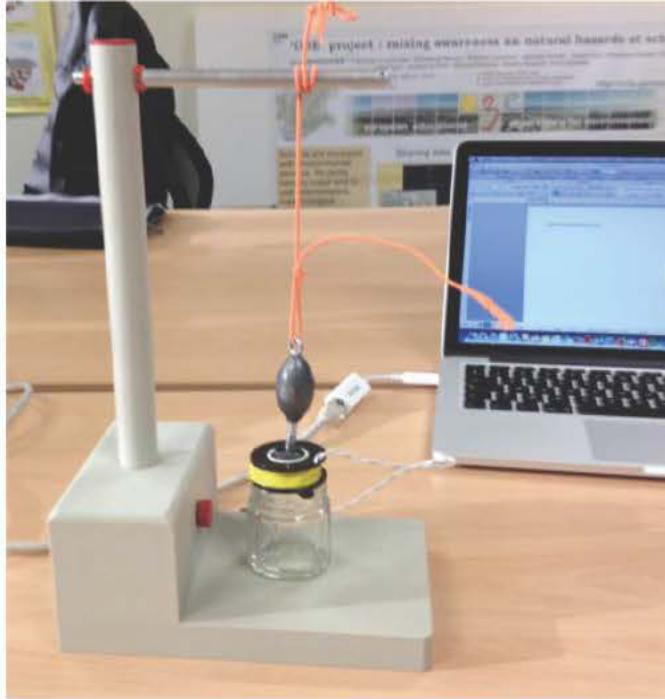
Topic 'SENSOR'

The instrumentation in relation with the planet environment



For Teens

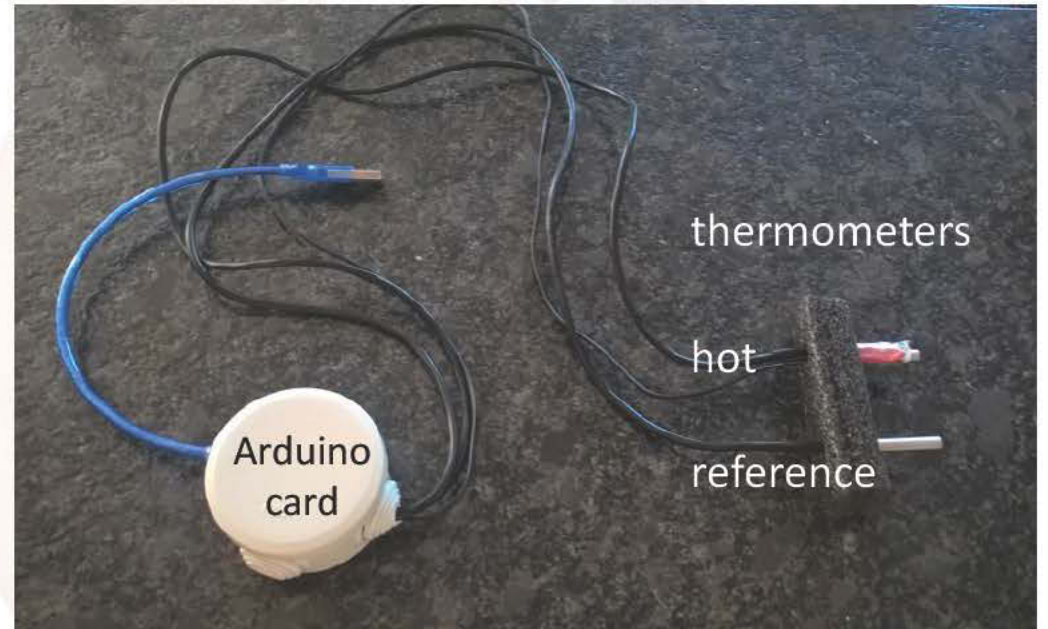
© J.L Berenguer



- How to record vibration, wind on Mars ?
- Model a seismometer, an anemometer
- Models to understand sensors ... and data !

For students

© J. Camponovo



Hot-wire anemometer



Topic 'SIGNAL'

The technical aspects of the data transmission

Topic 'SIGNAL'
The technical aspects
of the data
transmission



The technical aspects of the data transmission
Analyse data from the laser shot Earth-Moon
Reception, transmission of the signal between
planets

and more ...



Topic 'SENSOR'

The instrumentation in relation
with the planet environment

Topic 'JOURNEY'

The travel from Earth to mars

Topic 'DATA' :

On-line published data for schools

Topic 'TELLURIC'

Hands-on activities about planetology

Let's see some examples >

© Fabrice Mourau

Distance Terre Lune

511998 213223121731439026629923314973301910 80 1029 11 88610 11519 5320a 524

explication du format (exemple de la première ligne)

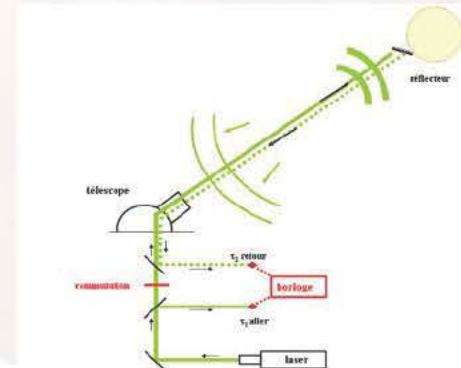
5	identification du format	1 caractère
1	couleur du laser (1 = vert 2 = infrarouge)	1 car.
19980213	date (année mois jour)	8 car.
2231	heure minute	4 car.
217314390	secondes (au moment du tir) (l'unité est la centaine de nanoseconde)	9 car.
26629923314973	mesure (l'unité est le dixième de picoseconde)	14 car.
3	réflecteur	1 car.
	0 = Apollo XI	
	2 = Apollo XIV	
	3 = Apollo XV	
	4 = Lunakhod 2	



The laser shot Earth Moon

For Teens

- Understand relation between distance and time ?
- Calculate distance Earth-Moon !
- ...



Laser reflector – Apollo 14

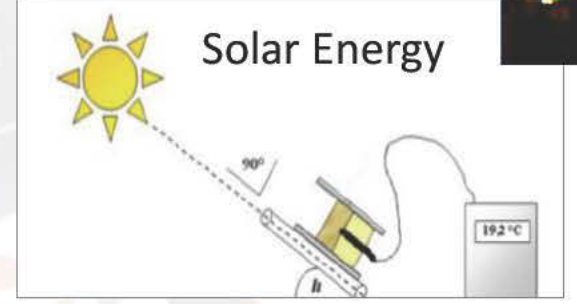
Topic 'SIGNAL'

The technical aspects of the data transmission




For students

© J. Camponovo



Preparer le lancement des mesures : ce qui doit être vérifié

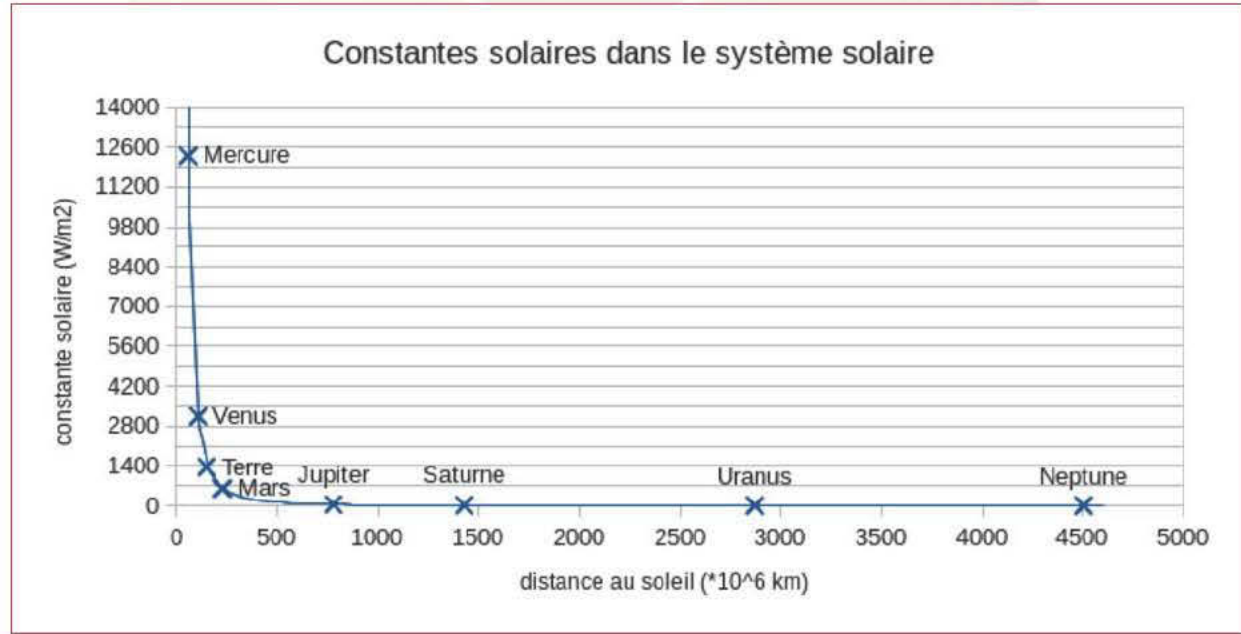


L'ECRAN DE L'ORDINATEUR MONTRE DEUX AXES GRADUES AVEC LES UNITES.

L'INDEX EST SUR LE « 0 cm » DE LA REGLE.

LE LUXMETRE EST A CÔTE DE LA LAMPE.

- Understand how solar energy decreases with distance ?
- Model and understand how signal decreases
- ...



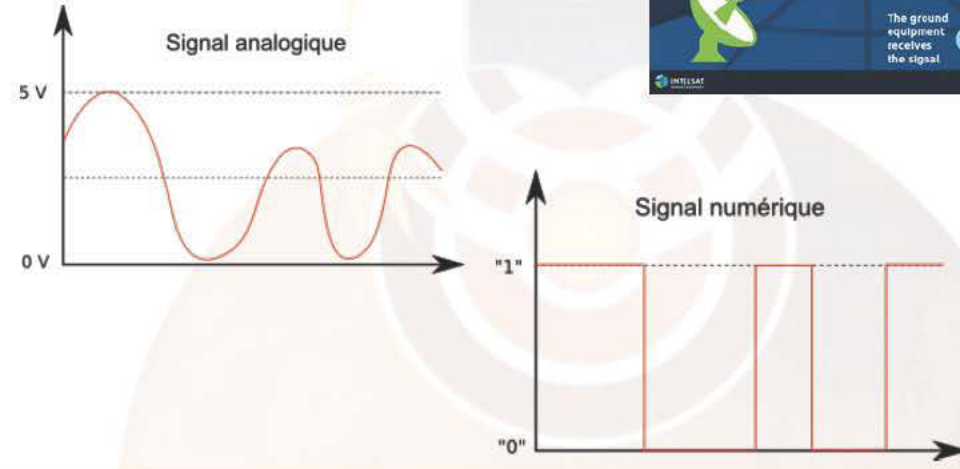
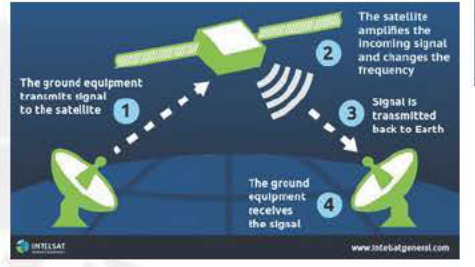
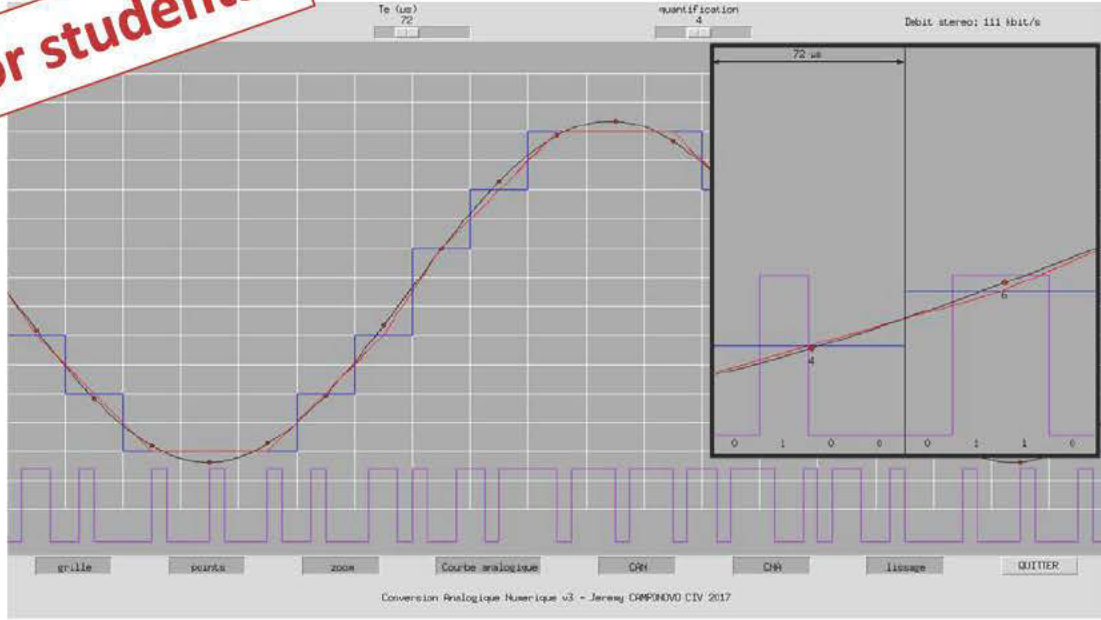
Topic 'SIGNAL'

The technical aspects of the data transmission



For students

© J. Camponovo



- From analogic to numeric signal ... and reverse ?
- Electronics aspects ... computing ...
- ...

```
from tkinter import *
from math import sin,exp,pi

class Courbeana(Canvas):
    "Canevas specialise, pour dessiner une sinusoide analogique puis la numeriser"
    def __init__(self,boss,haut=500):
        Canvas.__init__(self)
        #self.larg=1000
        self.larg=fen.x
        self.configure(bg='dark gray',width=self.larg,height=haut)
        self.grid(row=1,column=0,columnspan=8)
        self.haut=haut

        self.temps=IntVar()
        #125 micro seconde entre deux echantillonnages et 4 bits correspondent au telephone
        self.temps.set(125)
        self.echantillon=Scale(boss, label="Te (µs)",variable=self.temps,length=120, from_=2,to=250,orient=HORIZONTAL,command=self.gen)
        self.echantillon.grid(row=0,column=2,columnspan=2)
        self.nombrebit=IntVar()
        self.nombrebit.set(4)
        self.bit=Scale(boss, label="quantification",variable=self.nombrebit,length=120, from_=1,to=8,orient=HORIZONTAL,command=self.gen)
        self.bit.grid(row=0,column=4,columnspan=2)
```


Share with the educational community

... A thematic distribution of resources

Web site

Discover and download data & resources

KIDS

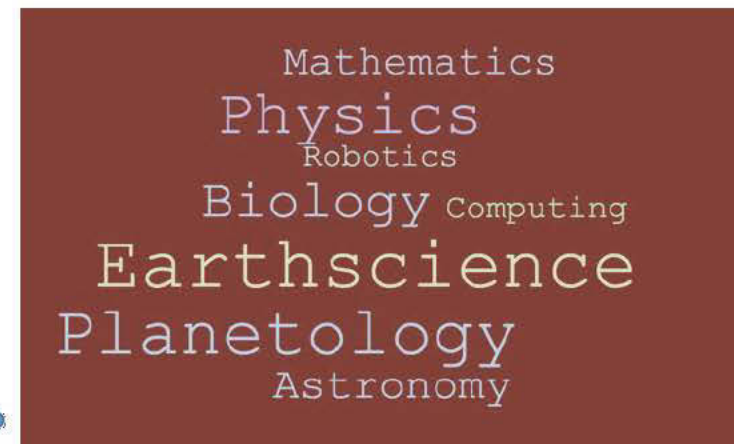
TEENS

STUDENTS



Teachers Room

Workshops for teachers to meet and share with scientists



Discover and download data & resources

SEIS portail (<http://seis-insight.eu/>)

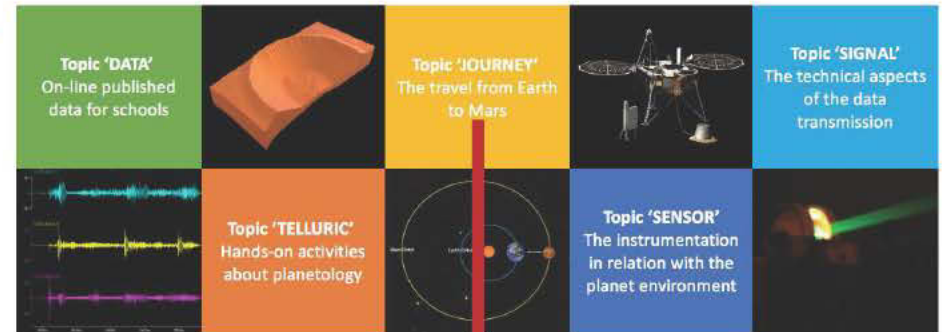


Project access

Outreach pages and links to Education partners

Example: French Education partner

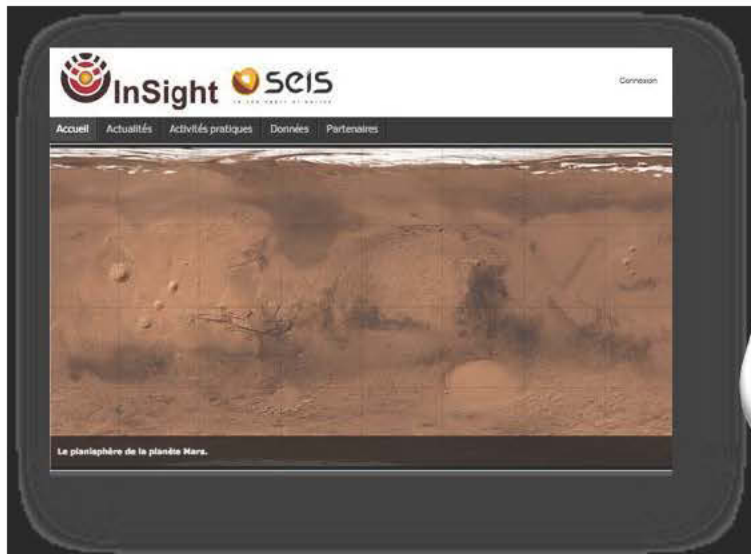
<http://insight.oca.eu>



KIDS

TEENS

STUDENTS



Resources for teach with INSIGHT

© D. Carrer / F. Moujdi

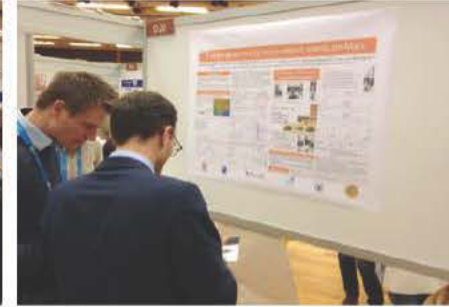


SEIS INSIGHT BOX

© BGS – P. Denton

2016.04.16-18. EGU GIFT, Vienna

80 teachers from 20 countries
Science Conference by Ph. Lognonné
Hands-on for the classroom
2 posters for Education



2016.10.5-7. seismology@school, Nice

50 teachers from 'SISMOS à l'Ecole'
Science Conference by L. Rolland
Hands-on for the classroom
SEIS INSIGHT box & Science Exposition



2017.05.9-10. OETF Meeting, Nice

30 teachers – Formative session
Workgroups to create new activities
Physics, Earth Science, Mathematics
Outreach projects



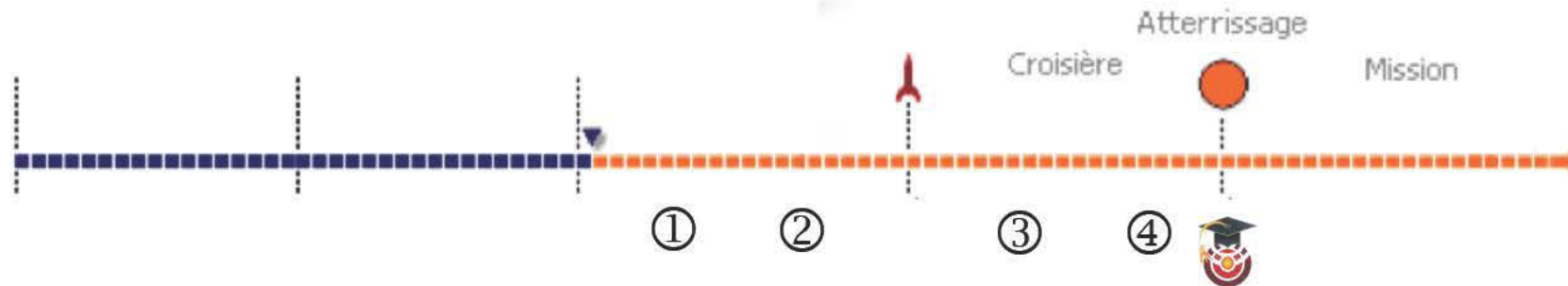
2017.11.2-3. SERA Workshop, Bucarest

80 teachers – Teachers workshop for SERA Project.
A specific session on InSight planned during this Scientix meeting



Next steps for SEIS INSIGHT Education Plan

- ① INSIGHT box 2.0 in the schools with resources / Jan. 2018
- ② INSIGHT mobile exposition for schools / Jan-July 2018
- ③ INSIGHT national teachers workshop / CNES Toulouse July 2018
- ④ INSIGHT and Euroscience Open Forum in Toulouse / July-Sept.2018



Ready for...

... INSIGHT !

