Laertiadae Classis

Presents...

Journey to Gusev

A project by
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ITALY

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Introduction

LAERTIADAE CLASSIS
JOURNEY TO GUSEV

The goal of mankind is to become a multiplanet species, otherwise the alternative is to remain on Earth forever and head straight for an eventual extinction event.

But why do we choose Mars?

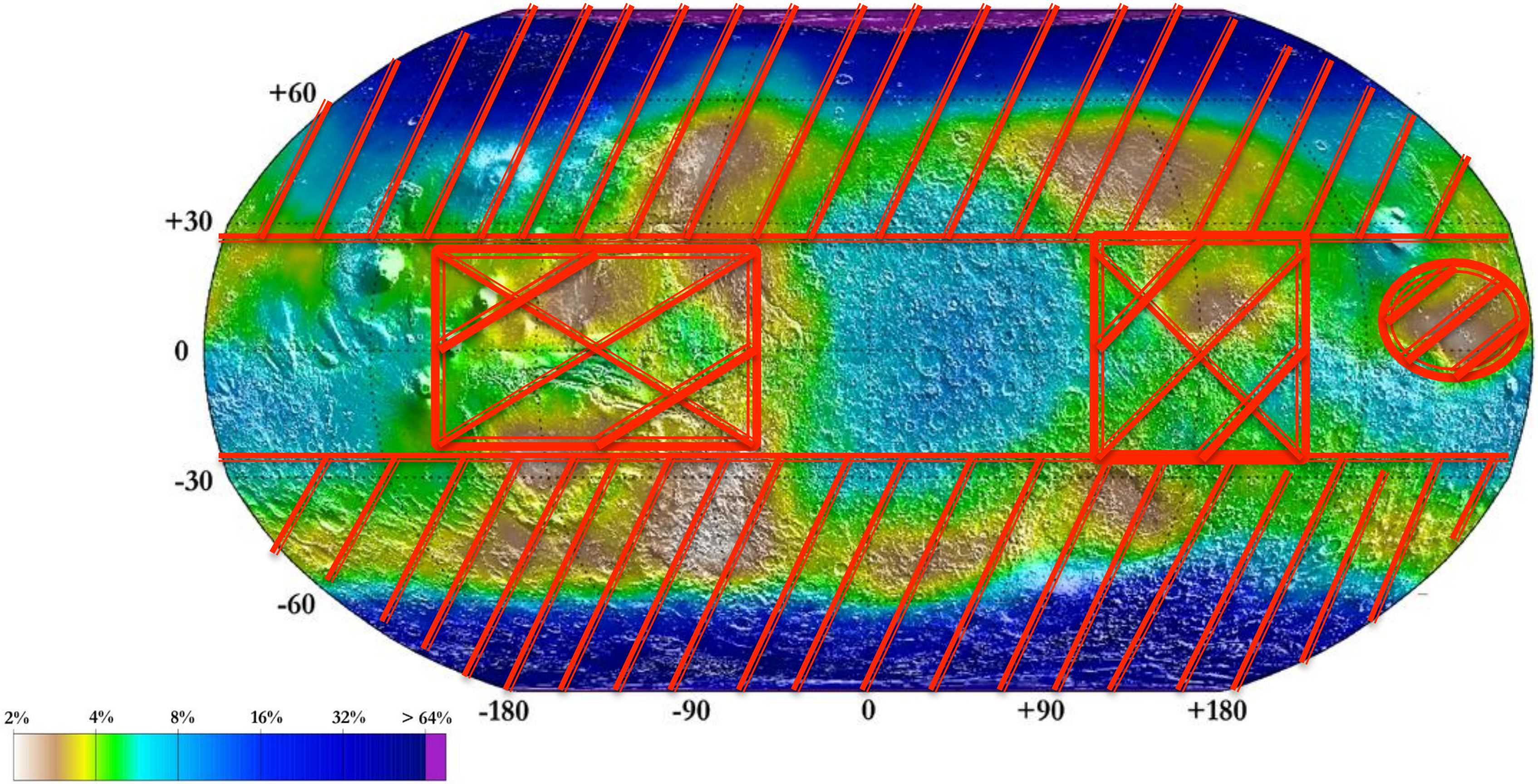
- We took in consideration all the planets of our Solar System, with a particular attention to the 3 rocky planets: Mercury, Venus and Mars. After several analysis we found that Mars is the best planet that human kind can colonize

Mars/Earth Comparison Table

	Mars	Earth
Atmosphere (composition)	Carbon dioxide (95,32%) Nitrogen (2,7%) Argon (1,6%) Oxygen (0,13%) Water vapor (0,03%) Nitric oxide (0,01%)	Nitrogen (77%) Oxygen (21%) Argon (1%) Carbon dioxide (0,038%)
Atmosphere (pressure)	7,5 millibars (average)	1013 millibars (at sea level)
Equatorial Radius	3397 kilometers	6378 kilometers
Gravity	0,375 that of Earth	2,66 times that of Mars
Length of Day	24 hours, 37 minutes	24 hours
Length of Year	687 Earth days	365 days
Surface Temperature	-63° C	14° C
Tilt of Axis	25°	23,45°

Landing Zone Selection

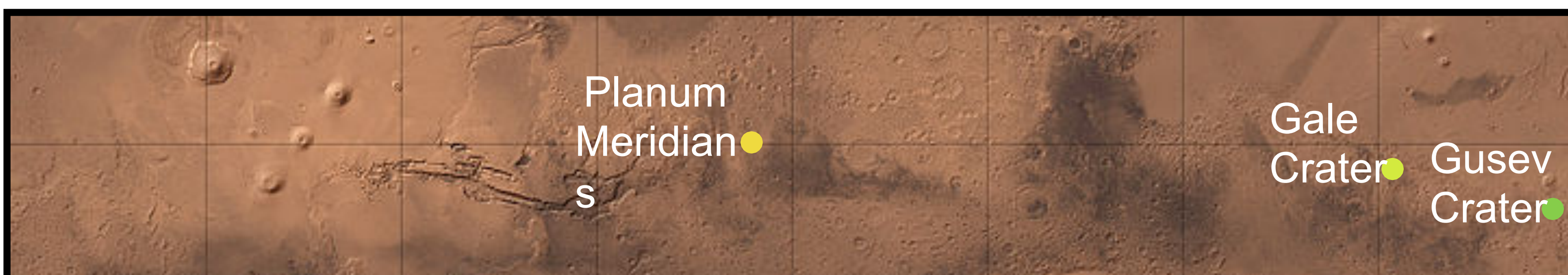
- <u>The best sites:</u> -25°< Latitude <25°
  Water >5%



Landing Zone Selection

- The finalist sites:

Site	Latitude	Water Availability	Geological interest	Biological interest	Final mark
Gale Crater	-5.4°	≈7%	9/10	8/10	8
Gusev Crater	-14.5°	≈10%	8/10	10/10	9
Planum Meridians	≈0°	≈5%	7/10	6/10	7

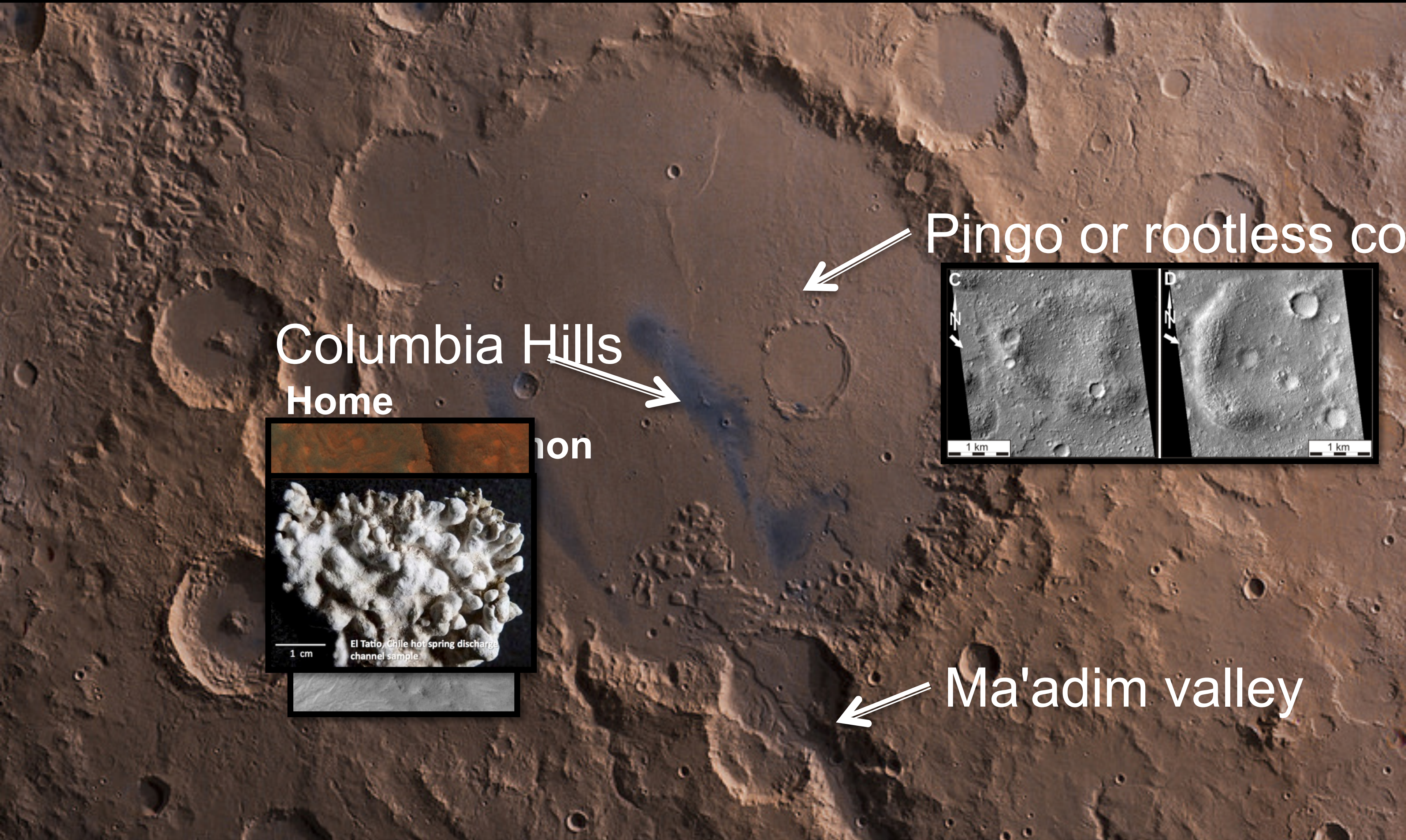


Gusev Crater

- Gusev Crater is an crater which took shape during the first half of Noachian period, when Mars was still damp and with a thick atmosphere.

- The water collected inside the crater, forming a lake , with a possible hydrothermal activity on the bottom.

Gusev Crater



Why do we use the ITS?

The Interplanetary Transport System (ITS), also known as the Mars Colonial Transporter (MCT), is the name of a project funded by the private company “SpaceX”.

Why do we use the ITS?

- The ITS is projected for a possible human settlement on Mars and it includes reusable launch vehicles and spacecraft. Its technology can also support some eventual exploration missions to other locations of our Solar System.

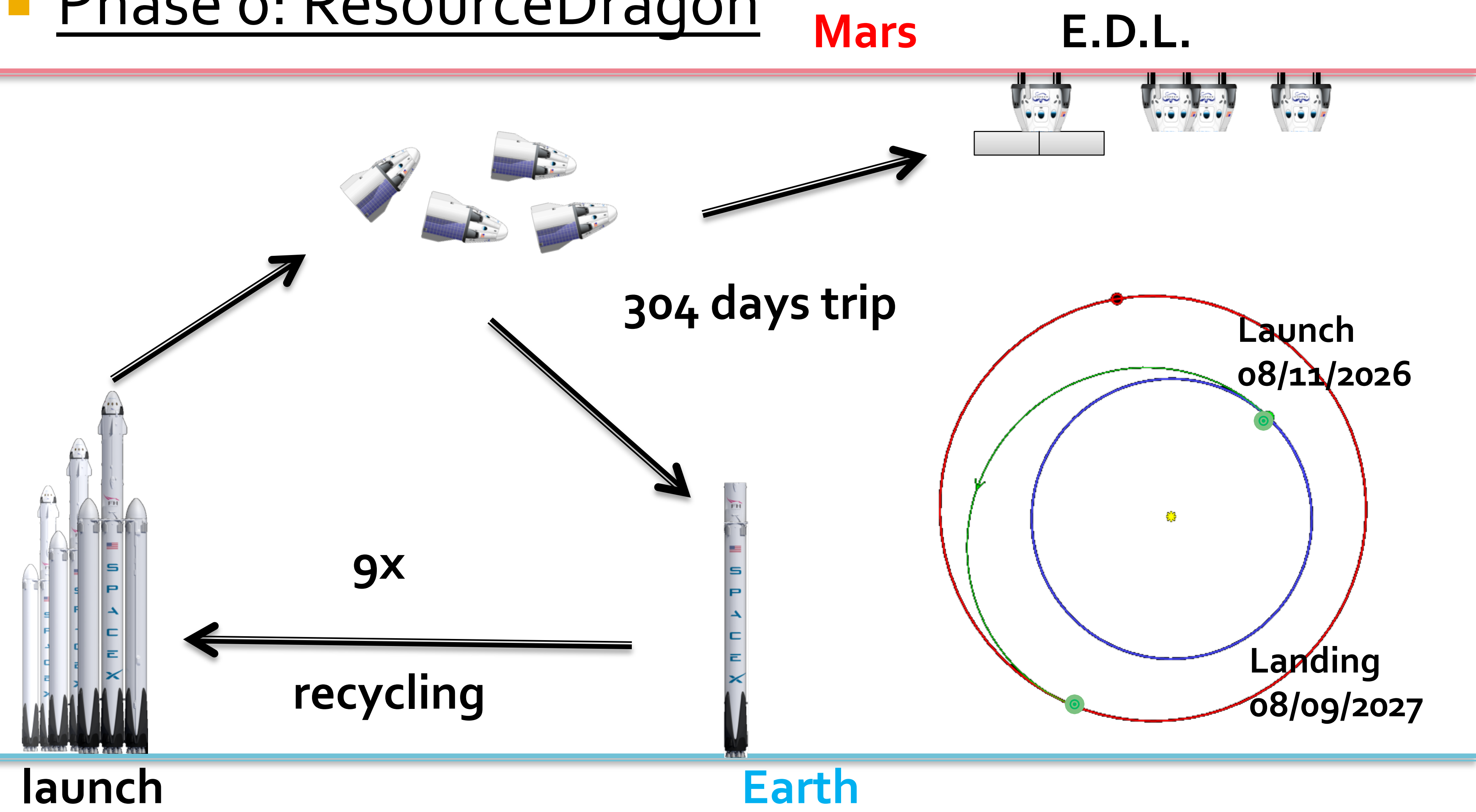
Length	49,5 m
Max Diameter	17,0 m
Propellant Mass	Ship: **1950 t** Tanker: **2500 t**
Dry Mass	Ship: **150 t** Tanker: **90 t**
Cargo to Mars	450 t (with transfer on orbit)

Why do we use the ITS?

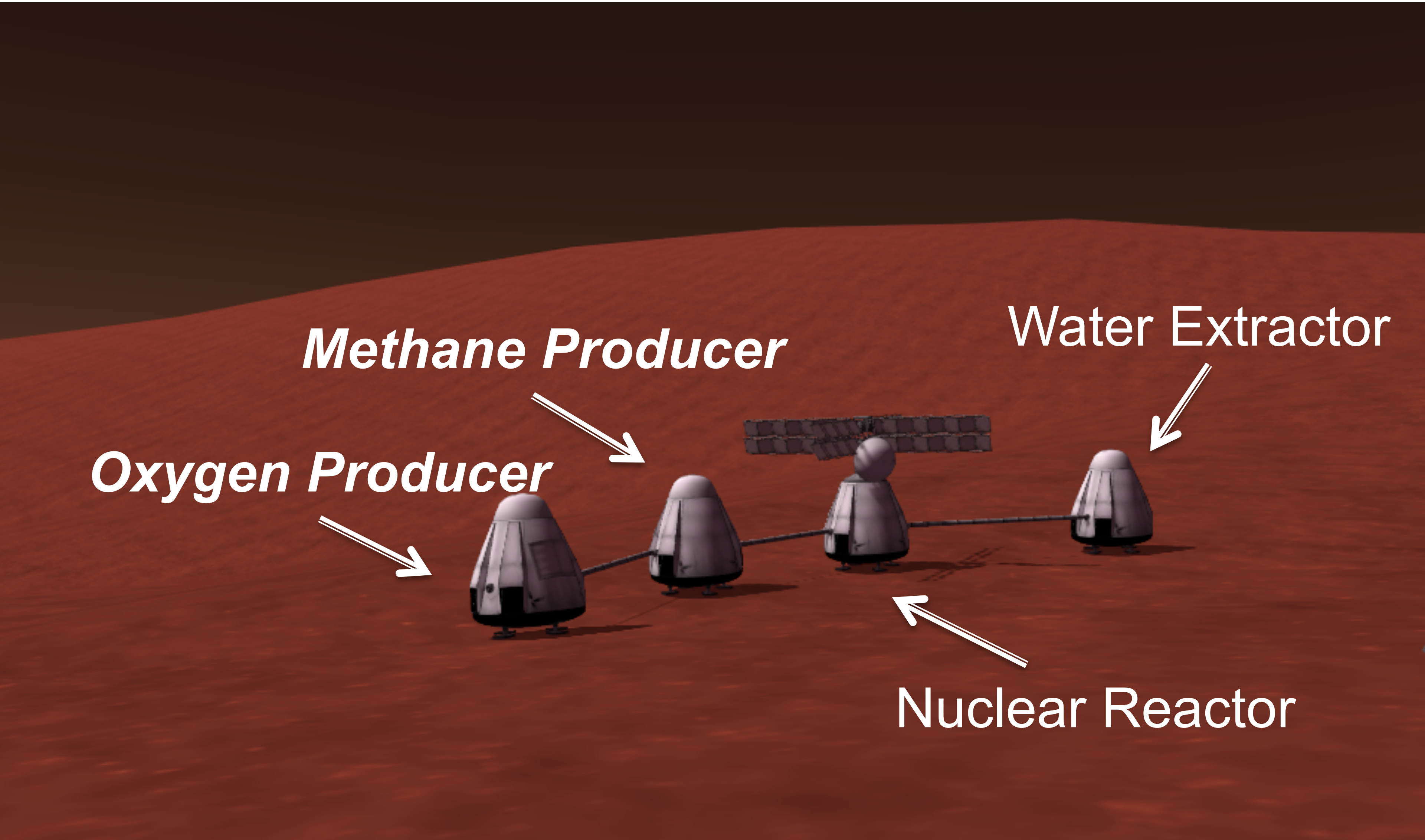
1. It comes from a private agency, so everybody can use it (international);
2. It is reusable, so it is not that expensive;
3. It can carry an heavy payload to Mars;
4. It is possible to modify the inner part.

Mission One - Profile

- Phase 0: ResourceDragon



ResurceDragon

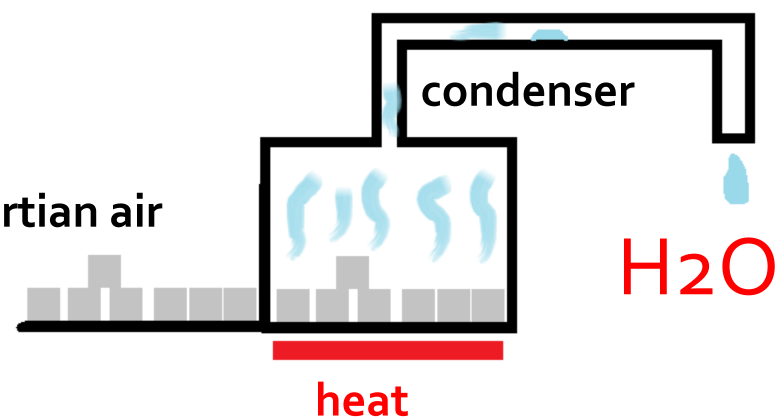


Resources production

- <u>Water extraction:</u>

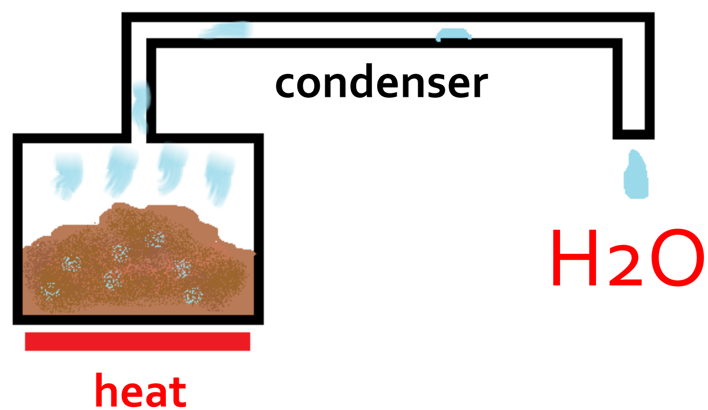
-<u>"Salt extraction":</u>

Another method is to capture the Martian humidity via salts by the atmosphere.



-<u>Soil mining:</u>

The soil is composed of a 10% ice; heating soil is possible to let ice evaporate and separate Water.

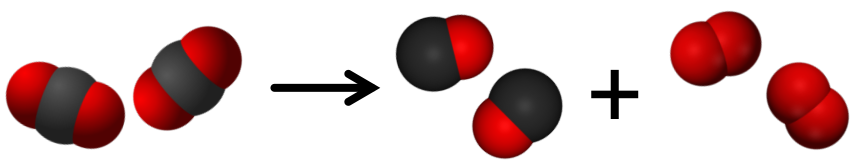


Resources production

Resources production

- <u>Oxygen Production:</u>

- A part of Oxygen can be generated from Martian CO_2 through this reaction:



$2CO_2$ $2CO$ O_2

- That is catalyzed by a series of Electroceramics, which detach an atom of Oxygen using electric current.
 The excess CO is expelled to the outside atmosphere.

Resources production

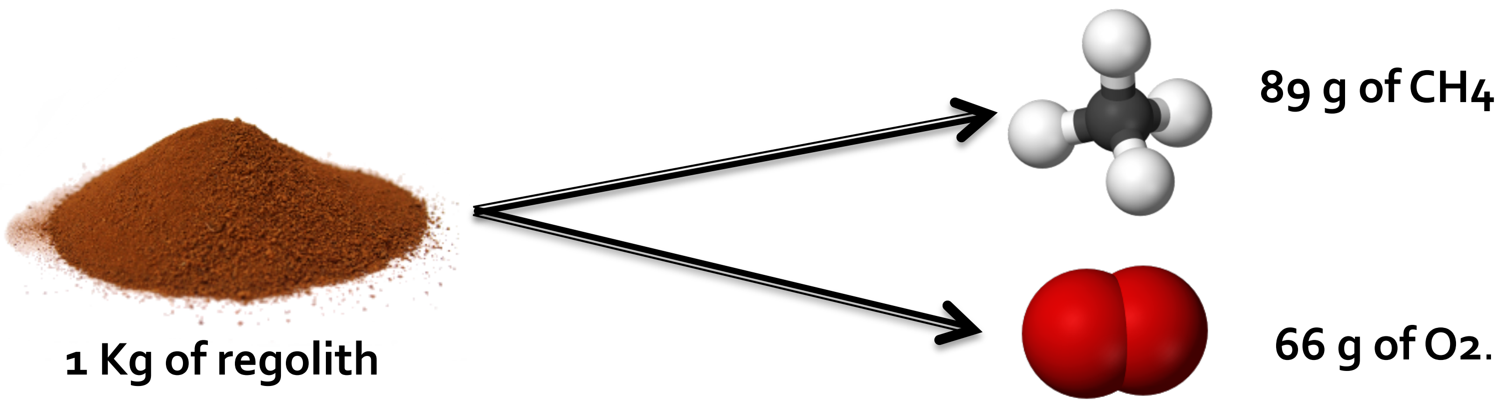
- <u>Fuel (Methane/ Oxygen) production:</u>

- The procedure to produce fuel is very long, so the cargo section should arrive on Mars more than a 6 year before the crew.

$$4H_2O \longrightarrow 2O_2 + 4H_2$$ electrolysis

Sabatier reaction $$4H_2 + CO_2 \longrightarrow 2H_2O + 4CH_4$$

Some Numbers…



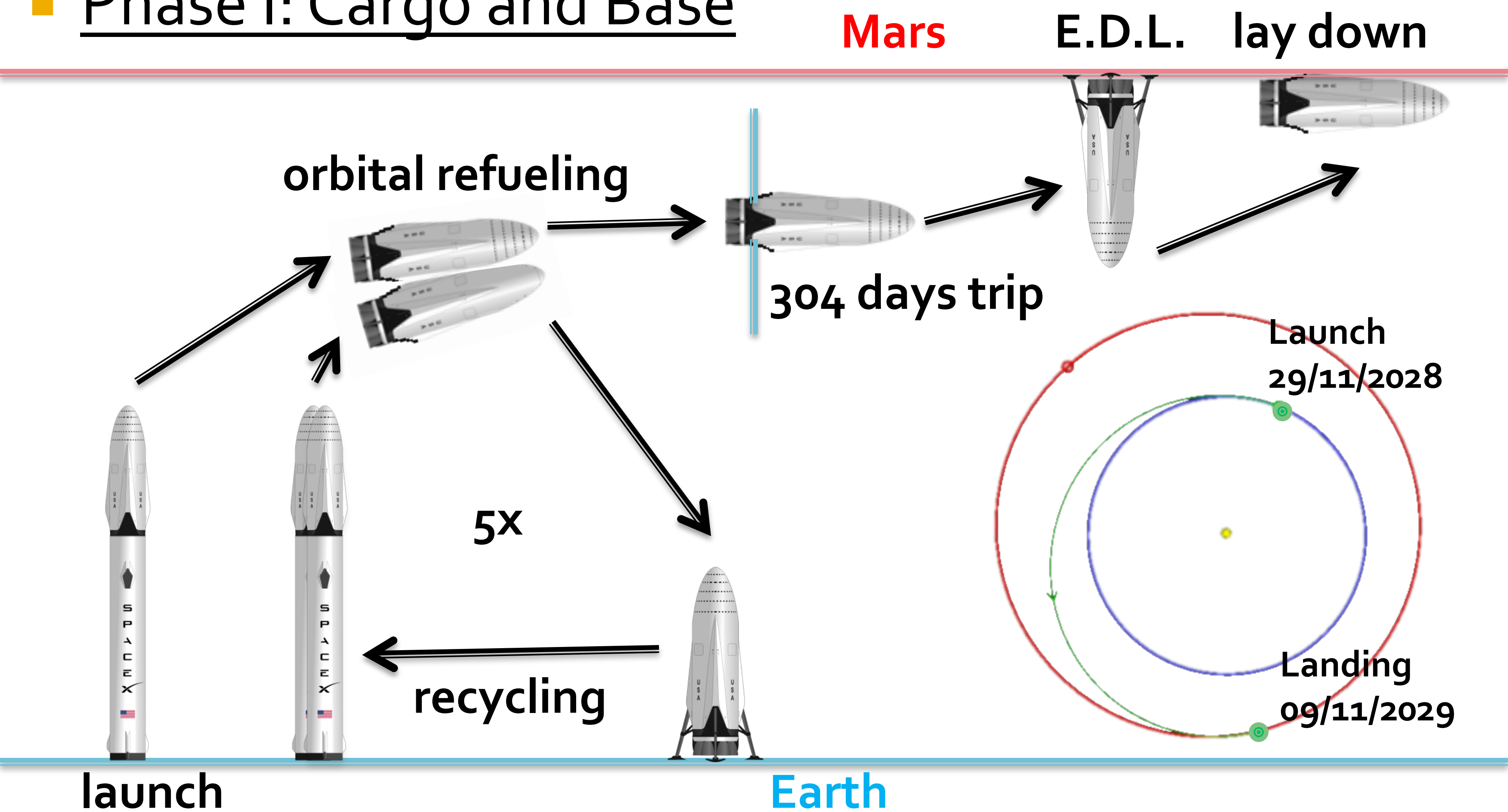
- We need **500 ton of CH_4**: it's necessary to work **4508 ton of regolith**. With this process we will produce also **297 ton of O_2**.

- The 'ResourceDragons' will work on Mars for **1450 days** (4 years). It means that they will produce **3 ton of regolith each day**.

The oven will have to heat about **0,09 m^3 of regolith in a hour**.

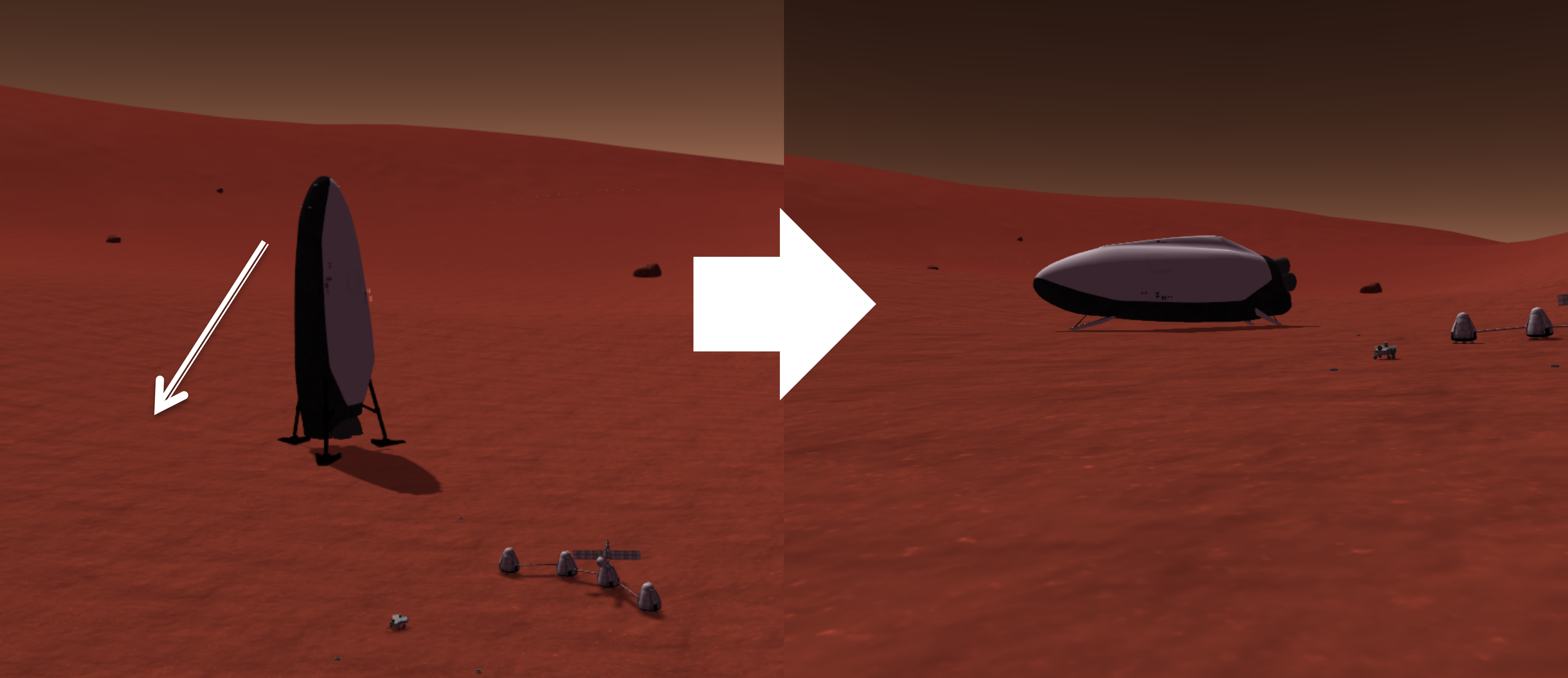
Mission One - Profile

- Phase I: Cargo and Base



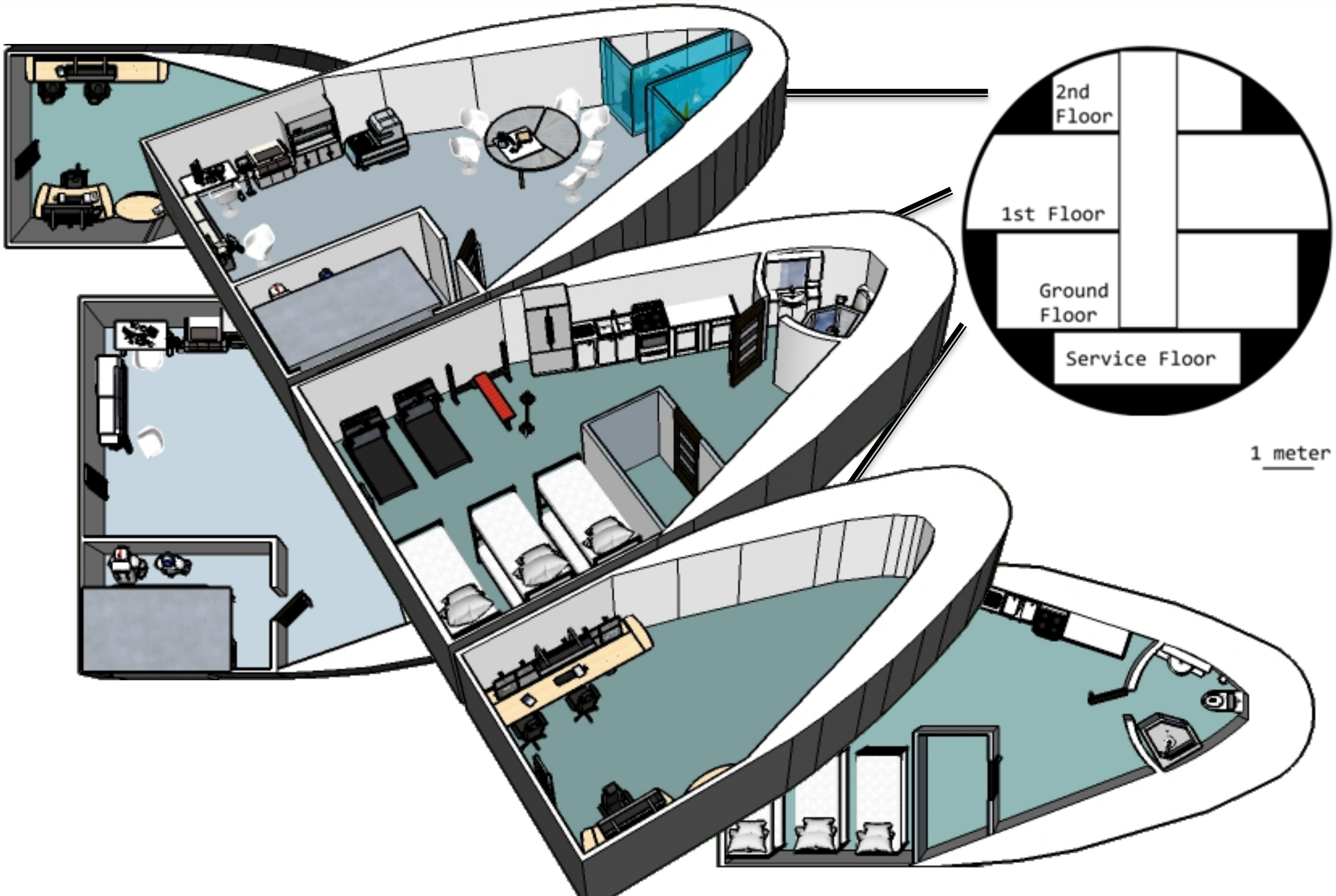
“Lay down” Maneuver

The most delicate maneuver is the one that allows to position the ITS/Base horizontally after landing.



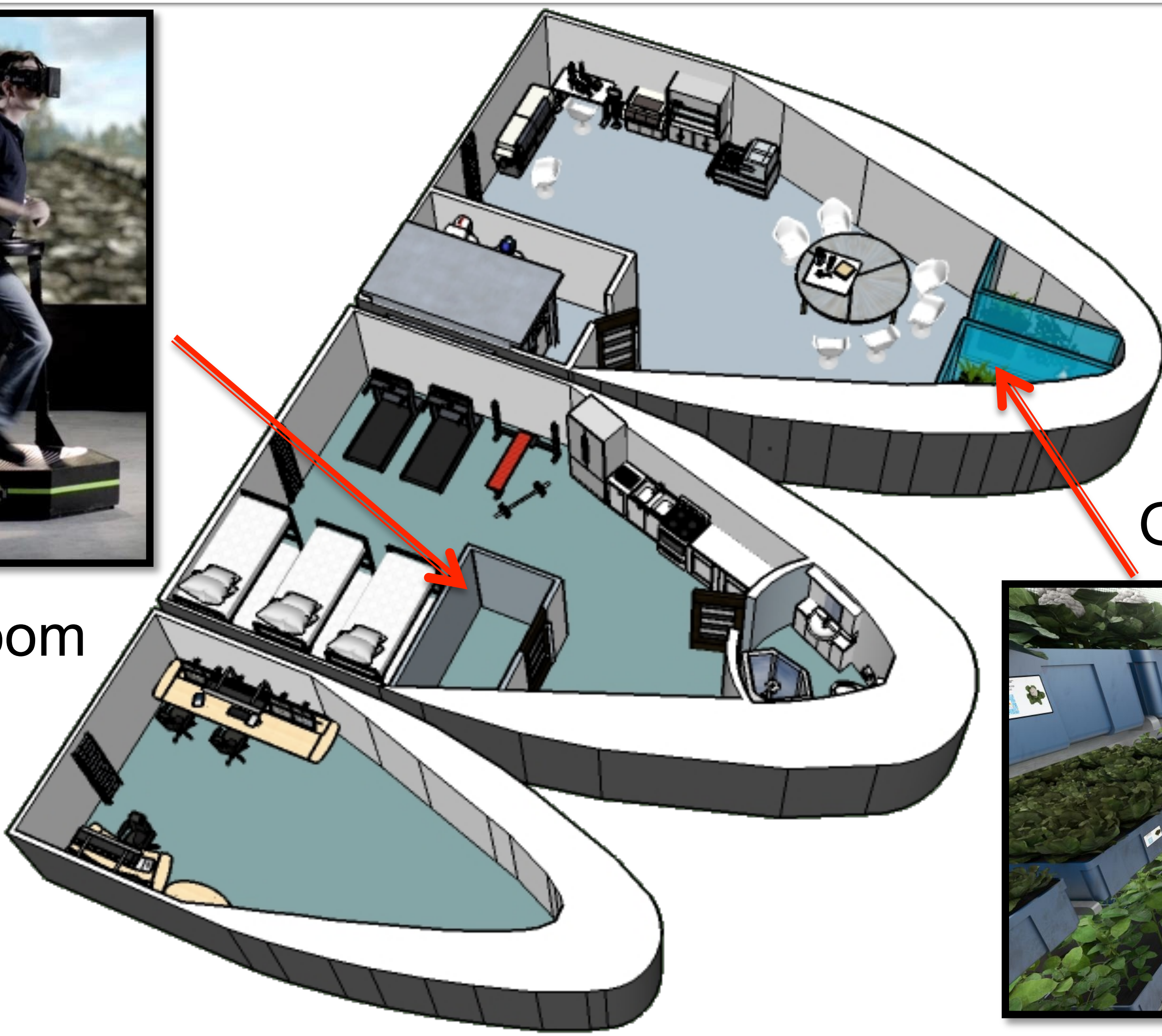
Landing position **Operational**

Base Planimetry



Base Planimetry

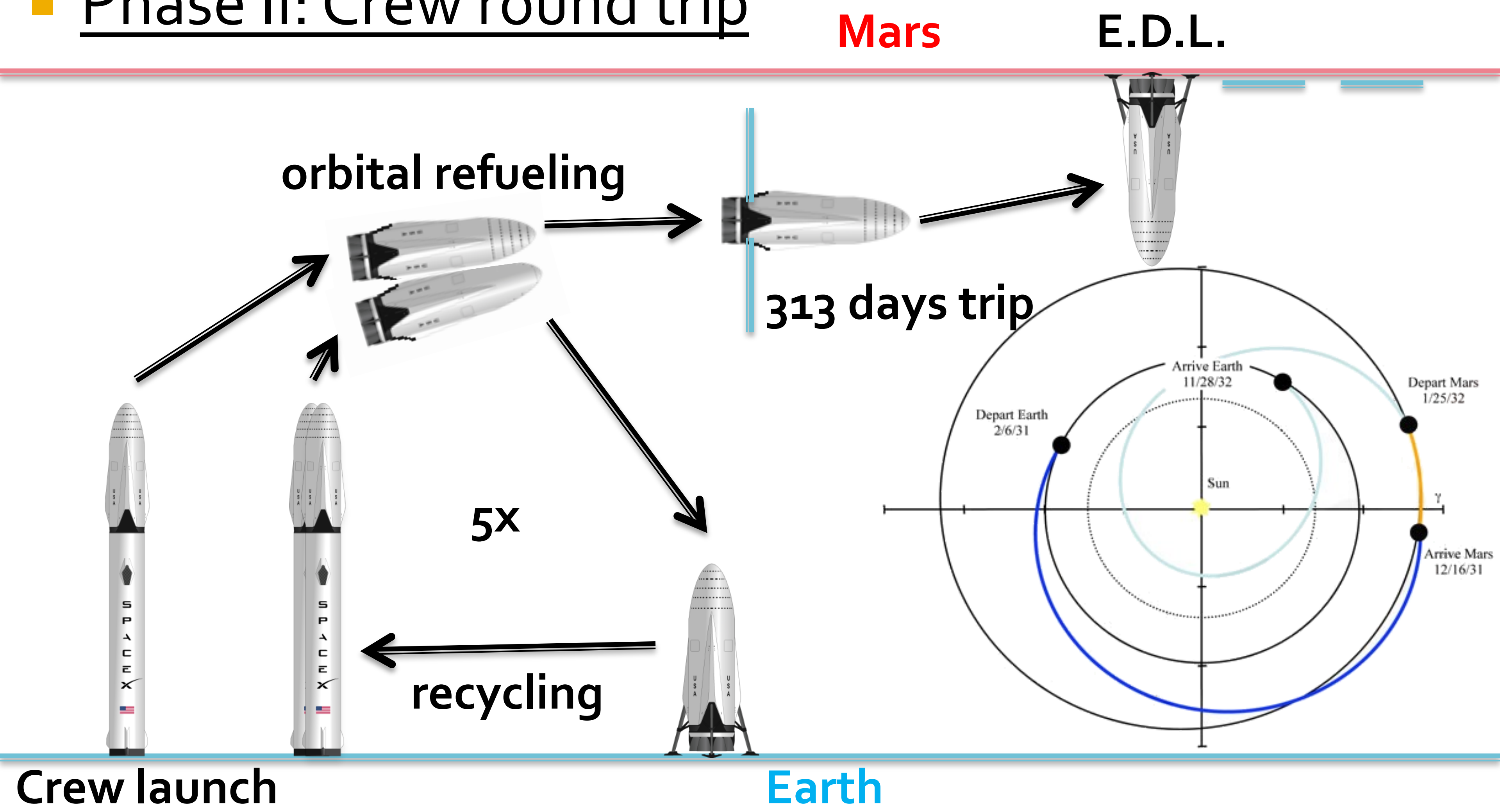
VR room



Greenhouse

Mission One - Profile

- Phase II: Crew round trip



Mission One

- Crew: 6 People (3 man and 3 women);
- Stay on Mars: 40 Days;
- Crew Launch: 6 February 2031
- Targets: -Install a first human outpost on Mars;
  -Search traces of Life;
  -Study the past of the Gusev Crater;

The crew

- 2 aerospace engineers;
- 1 medical doctor (who has some knowledge in biology);
- 1 biologist (who has some knowledge in medicine);
- 1 geologist (who has some knowledge in astrophysics);
- 1 astrophysicist (who has some knowledge in geology).

Weightlessness Solution

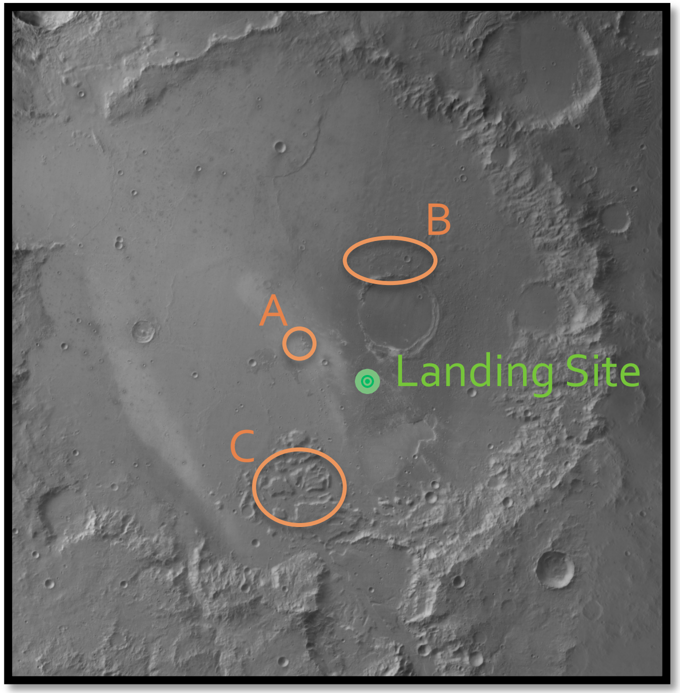
- <u>The Skin-Suit</u>

It is a particular suit which provides ‘loading’ in the head-to-foot direction, for recreating the load of gravity on Earth, but in weightlessness.

Surface Operation

- The crew will have a rover with which will realize 3 trips, each towards a Region Of Interest (ROI):

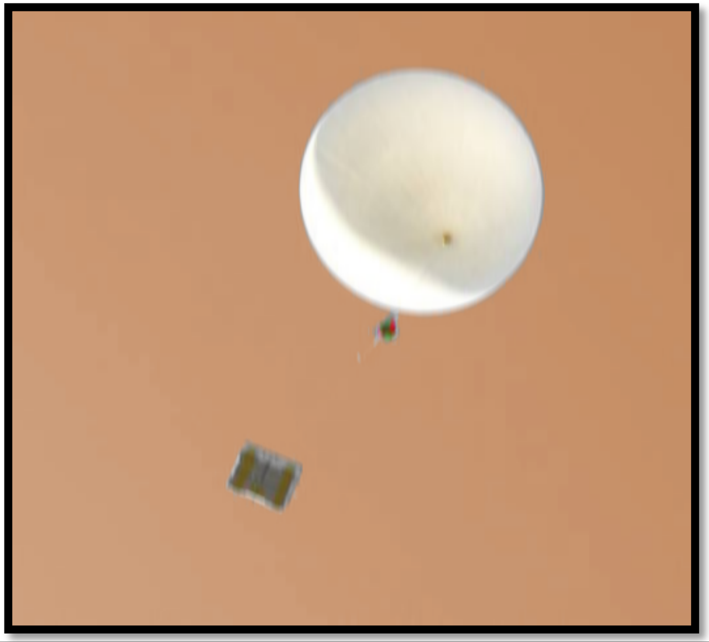
Site	Distance	Travel Time	Coordinates
Landing Site	0 Km	0 hours	14°47′ 25″ S 175° 51′ 54″ E
Columbia Hills (A)	22 Km	1 hours	14° 35′ S 175° 31′ E
Pingo (B)	33 Km	1.65 hours	14° 14′ S 175° 57′ E
Ma'adim delta (C)	40 Km	2 hours	15° 20′ S 175° 31′ E



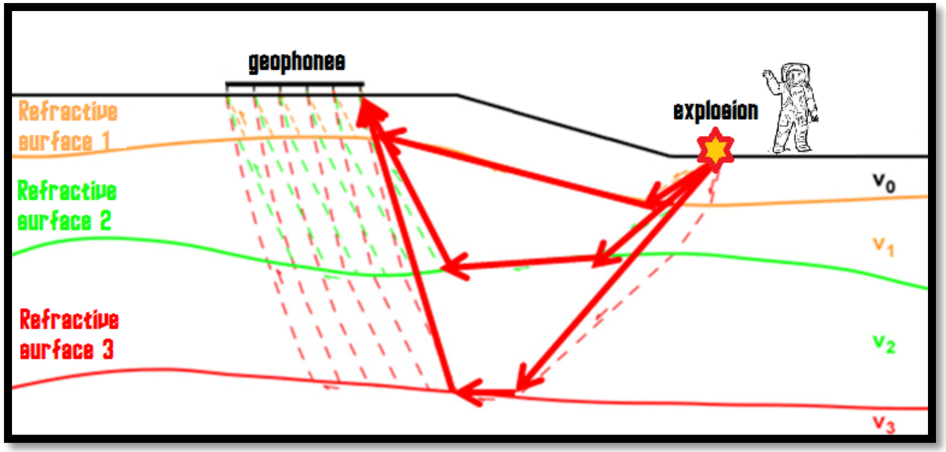
The travel times are based on the maximum speed of the rover 20 km/h

Surface Operation

Weather



Seismic survey

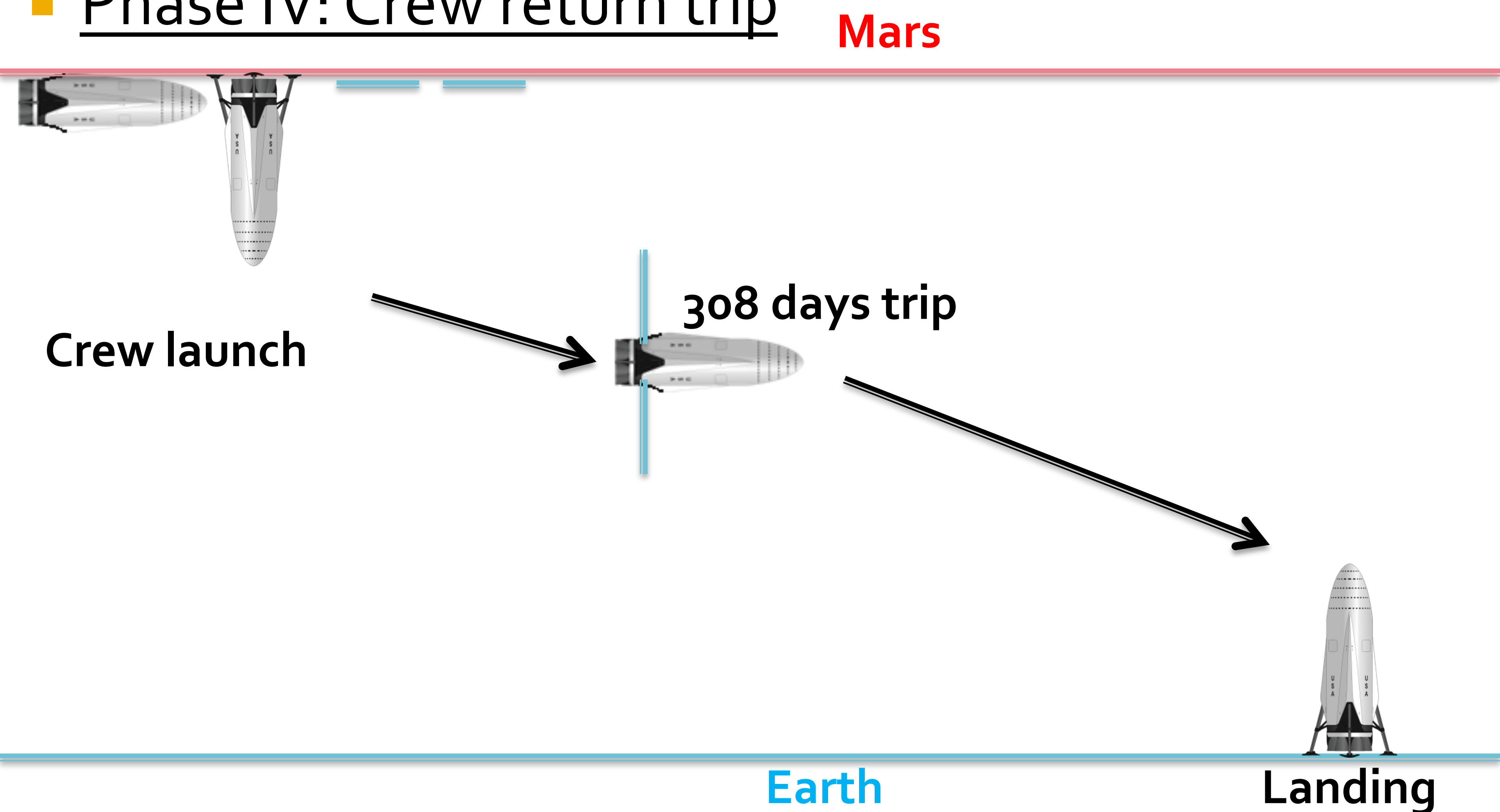


•A method f
structure an
of the Marti
high resolut

Thanks to this technique it is possible to analyze the subsoil placing some seismometers and blowing up small charges on the surface.

Mission Profile One

- <u>Phase IV: Crew return trip</u>

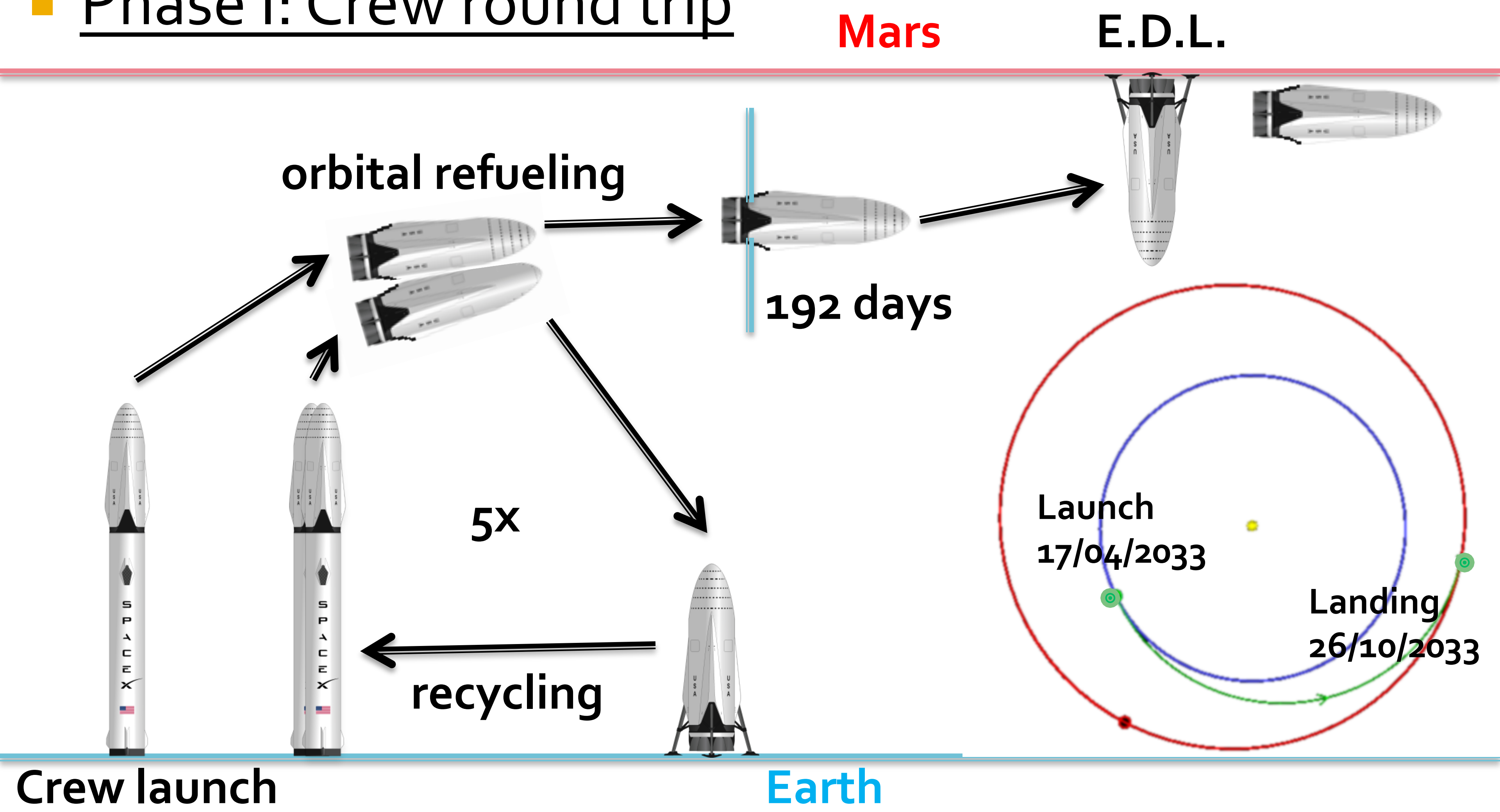


Mission Two

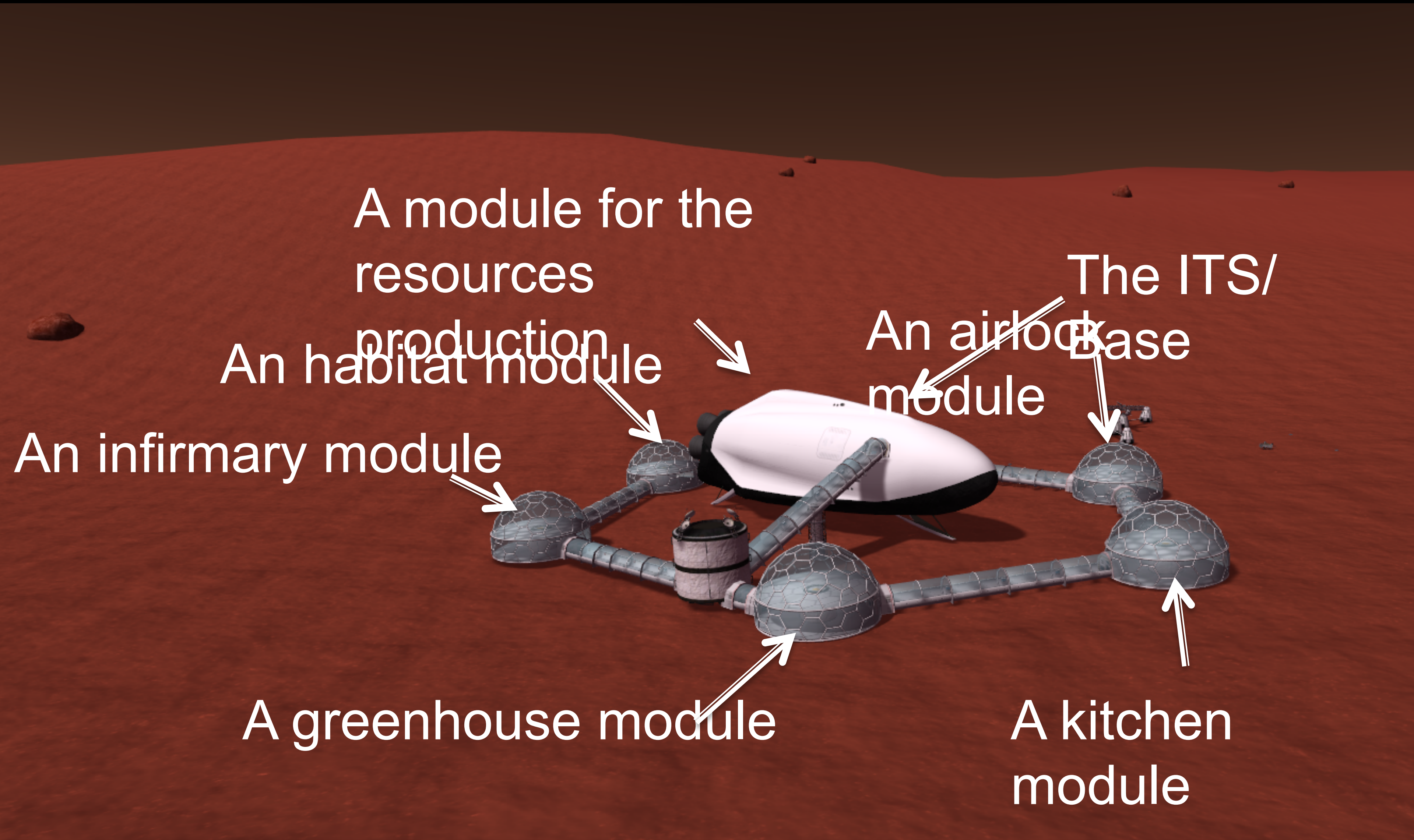
- Crew: 6 People (3 man and 3 women);
- Stay on Mars: more than a year;
- Crew Launch: 2033
- Targets: -Extend the Martian Base;
  -Characterize the environment of Gusev crater on the Long period;
  - Search traces of Life;

Mission Two - Profile

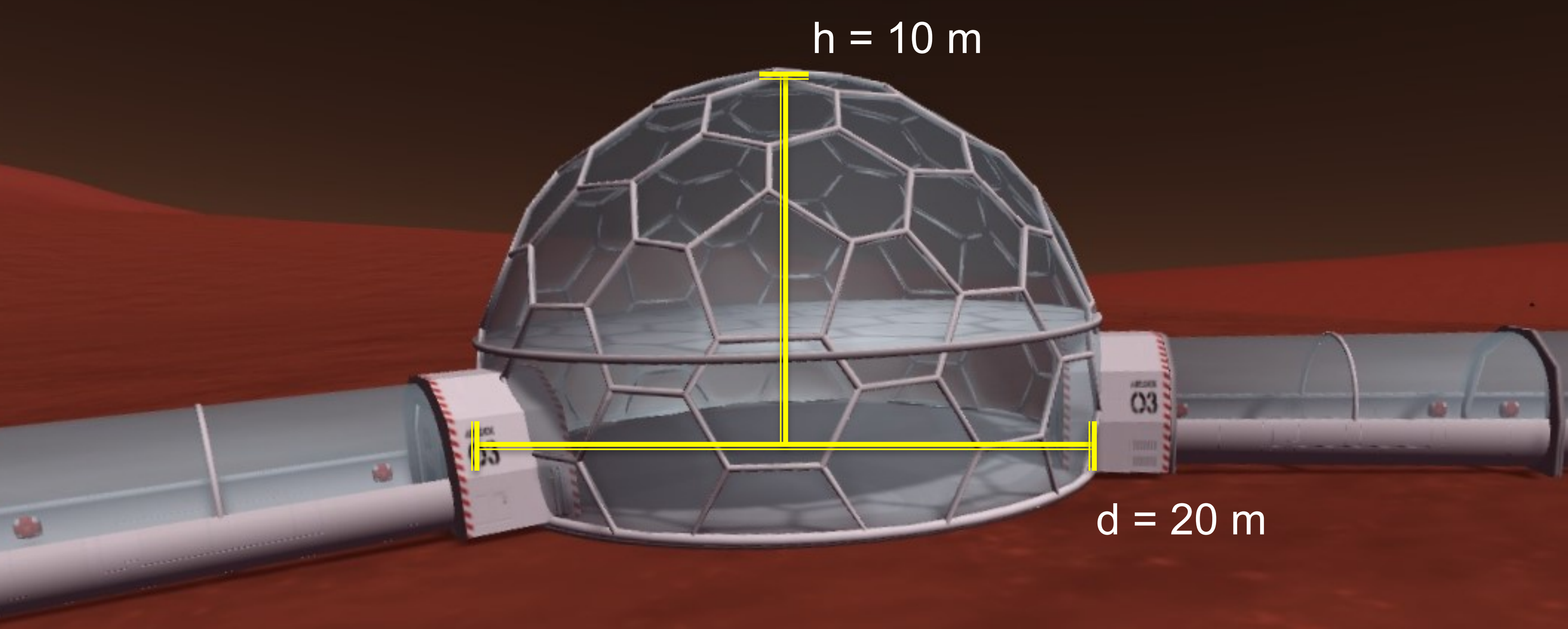
- Phase I: Crew round trip



Ithaca Outpost



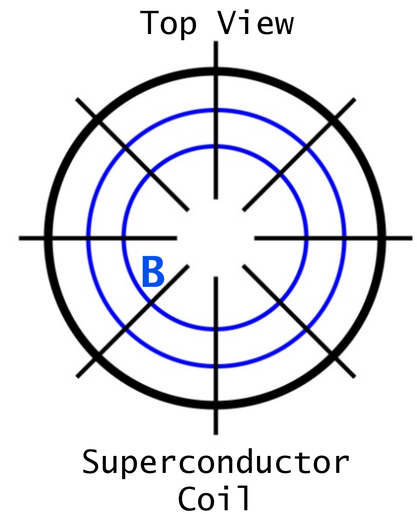
The Dome

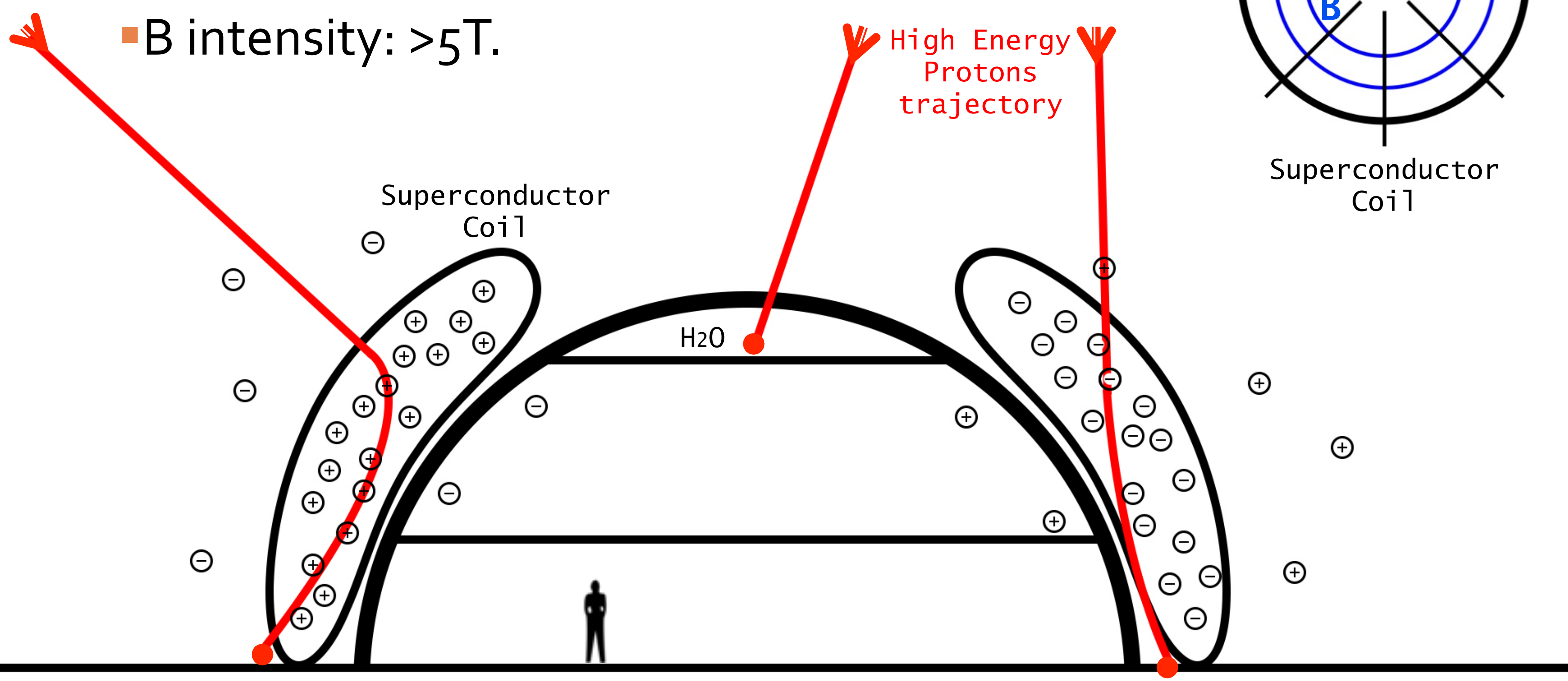


The modules will be divided into 2 floors. The first floor will be located to an height of 3,5 m from the ground floor, for a total surface of (about) **590 m²** usable.

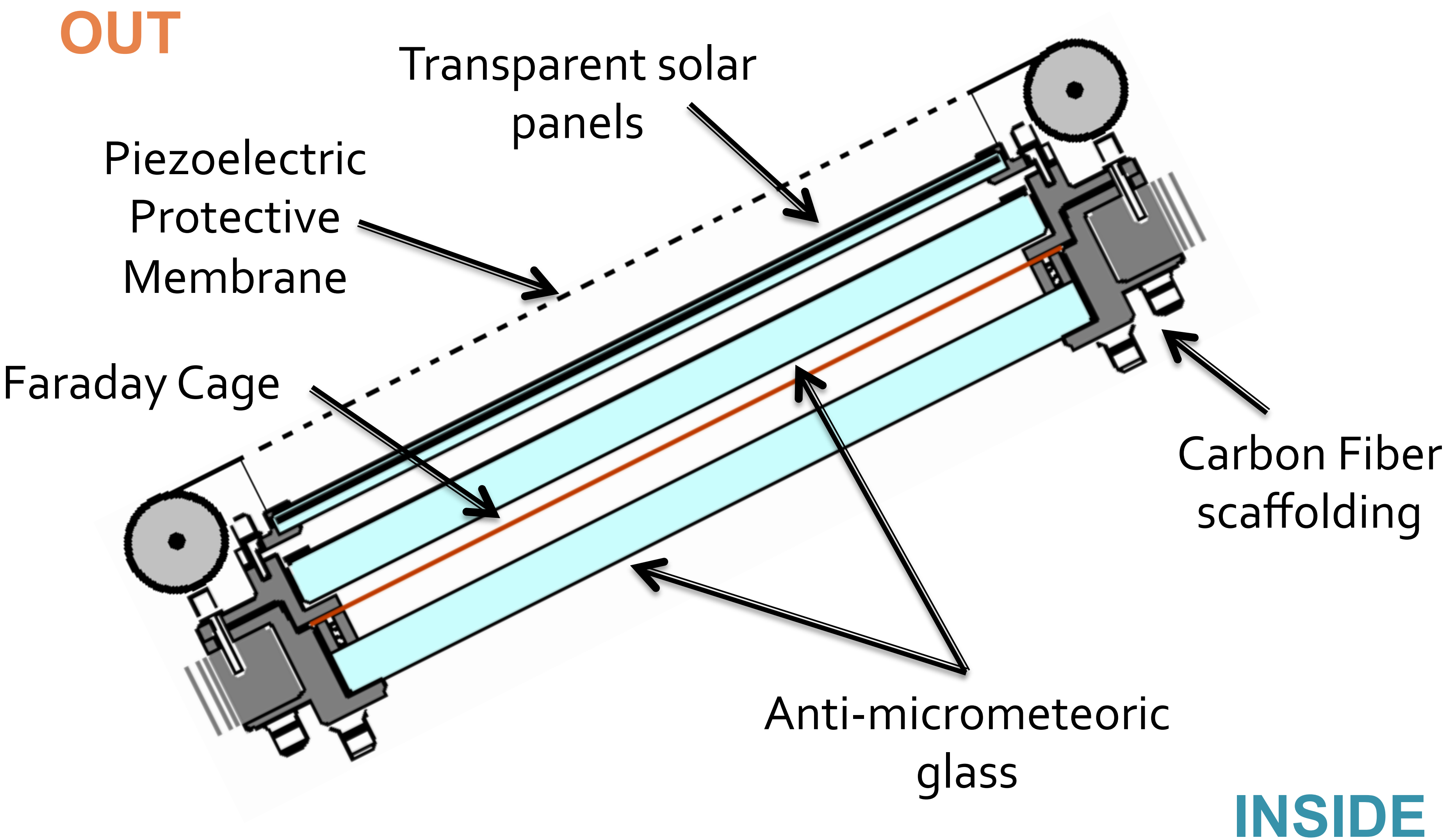
Radiation shielding

- Superconductor: SmFeAs(O,F);
- Cooling: LOX at 50K;
- B intensity: >5T.

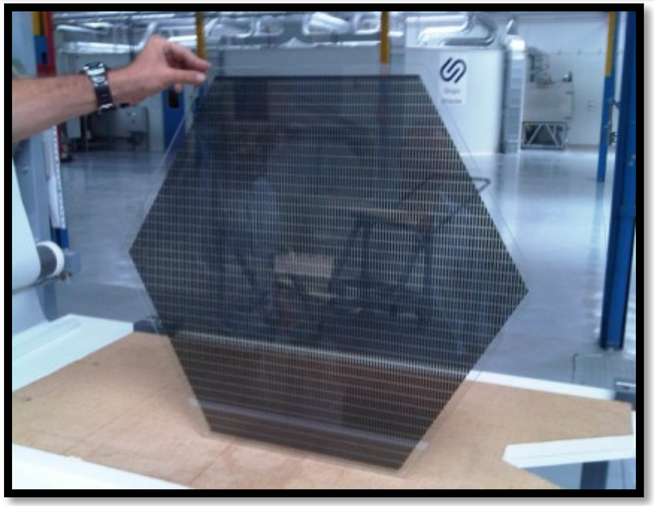




Window subunits



Energy production



Transpare
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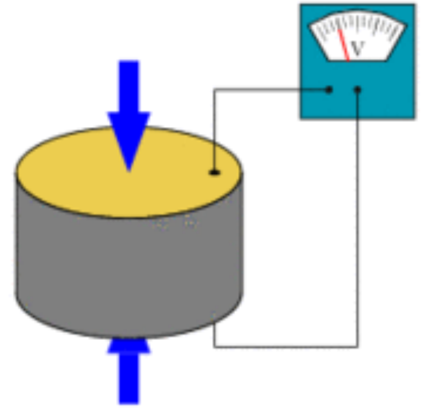
Panel



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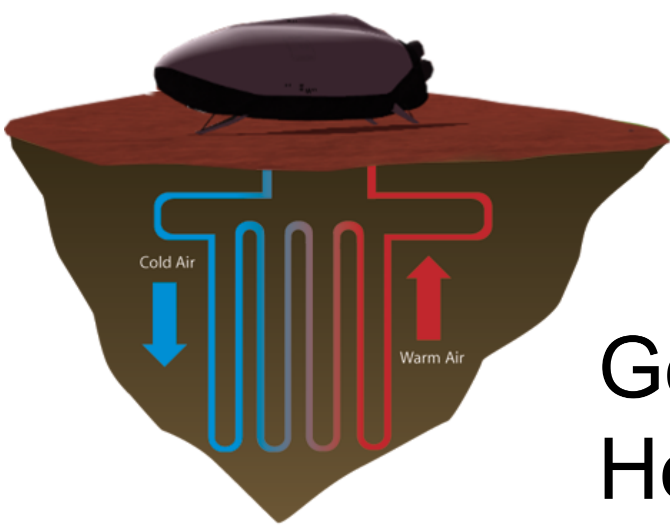


Geotherm
Heat Pump

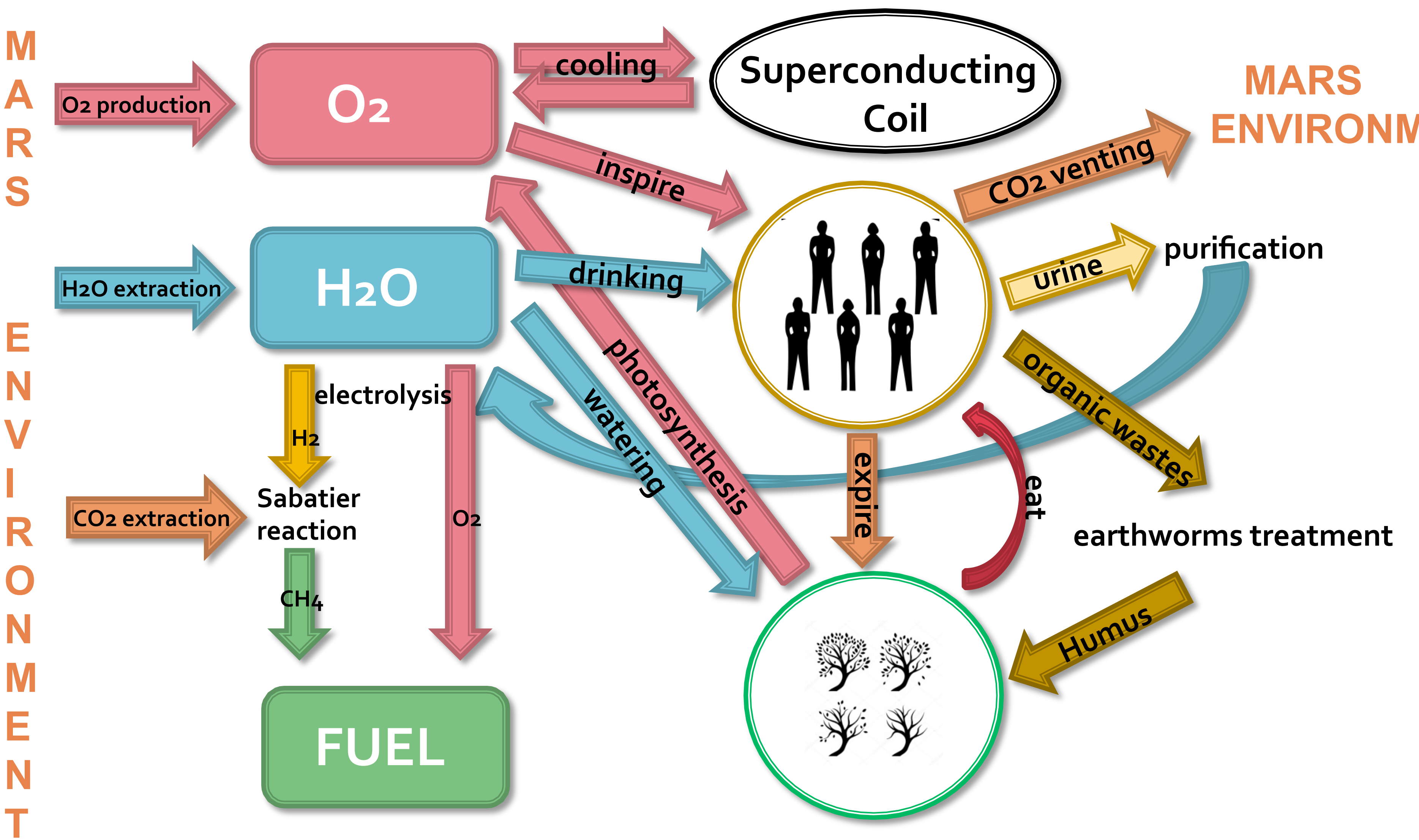
The Gusev Crater zone has been very active in the past and have a heat flow of about 7 mW/m^2; We use this heat to heat the base environments and produce energy.

Humus production

"Today's food will be tomorrow's food"

Growth's Plants Experiment

Resource Usage



Food On Mars

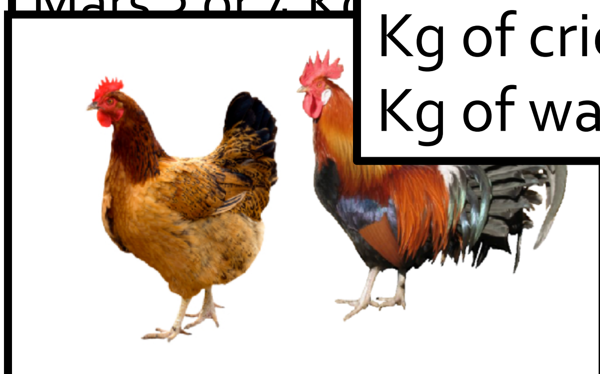
Trouts

We could thin

Mars 2 or 4 K

t

which live in



Roosters and hens

These kinds of insects are very rich in almost all the nutrients that the human body needs to survive. The crew can bring on Mars 1 Kg of cricket's eggs and 1 Kg of waxworm's eggs.

xworm

ssion it could

g on Mars

hen's eggs.

ce eggs,

f nutrients.

breed and

they can be feed with died insects or some vegetables and fruits.

Crickets

Food On Mars

Corn

Corn is a cereal
carbohydrates.
crew, hens and

Olives

Farming

We will beg

Lemons

ain C vitamin and
ood in case of

We can also plant some coffee's plants and use an "Espresso" coffee machine to brew good coffee.

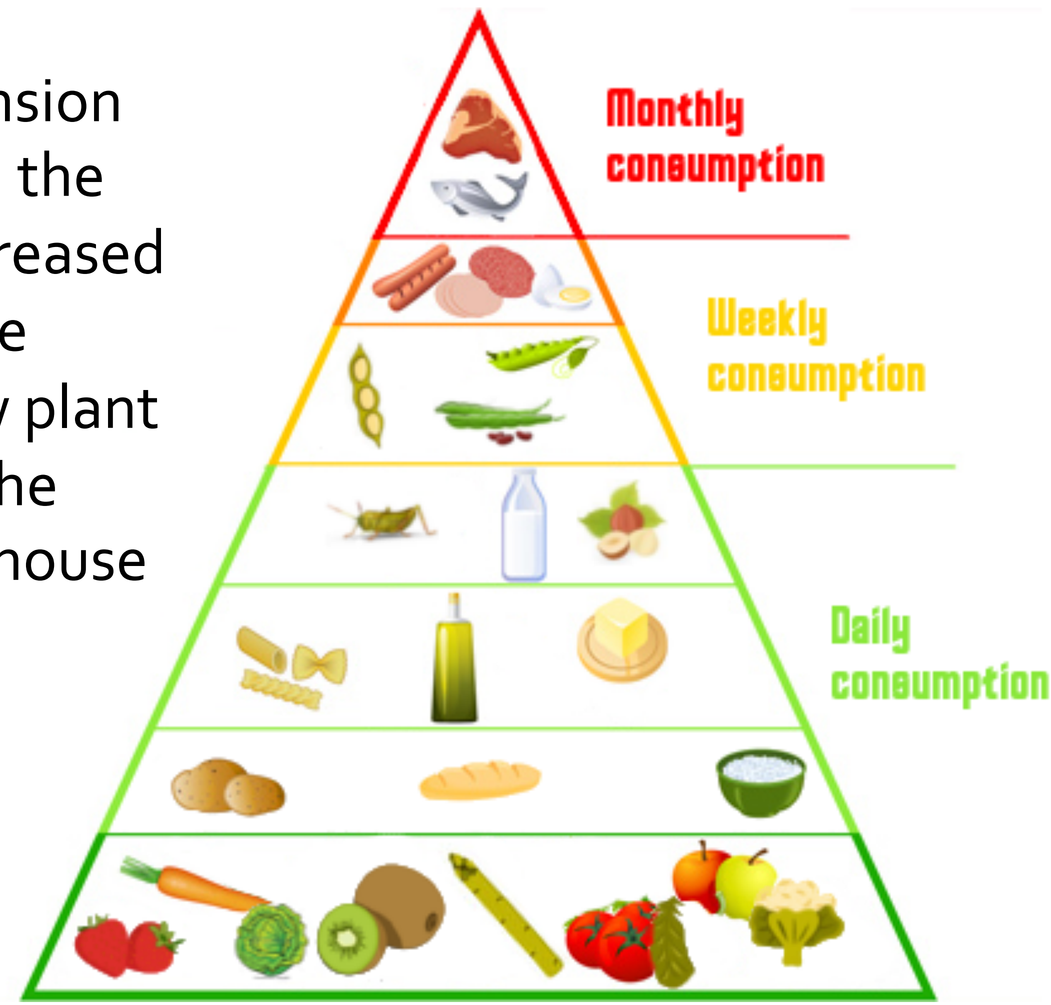
some of ther

possible to produce
oil on Mars.

Coffee

Astronaut Diet

- With the greenhouse extension during the second mission, the cultivable space will be increased to **$470\ m^2$**; this space will be cultivated with a lot of new plant species, which will enrich the astronauts diet. The greenhouse will make the base totally independent from Earth.



Astronaut Diet

Food	Carbs	Fats	Proteins	Sugars	Energy (Kcal) for 100 g
Apples	12,76 g	Minimum	0,27 g	10,1 g	48
Apricots	11,12 g	0,39 g	1,4 g	9,24 g	48
Oranges	11,75 g	0,12 g	0,94 g	9,35 g	47
Peaches	9,54 g	0,25 g	0,91 g	8,39 g	39
Strawberries	7,68 g	Minimum	0,67 g	4,89 g	32
Kiwis	14,66 g	0,52 g	1,14 g	8,99 g	61
Spinach	3,73 g	0,26 g	2,97 g	0,43 g	23
Asparagus	3,88 g	0,12 g	2,2 g	1,88 g	20
Tomatoes	3,90 g	Minimum	0,9 g	2,63 g	18
Lettuce	2,23 g	Minimum	1,35 g	0,94 g	13
Beans	47,5 g	2,0 g	23,6 g	3,50 g	291

Astronaut Diet

Food	Carbs	Fats	Proteins	Sugars	Energy (Kcal) for 100 g
Hazelnuts	17,6 g	Minimum	15 g	4,89 g	646
Carrots	9,58 g	Minimum	0,93 g	4,74 g	41
Potatos	17,47 g	Minimum	2,02 g	0,78 g	77
Olives	3,84 g	15,32 g	1,03 g	0,54 g	145
Zucchinis	3,35 g	0,18 g	1,21 g	2,2 g	16
Green Beans	6,97 g	0,22 g	1,83 g	3,26 g	31
Cane Sugar	98,09 g	0 g	0,12 g	97,02 g	380
Cocoa	51,39 g	23,17 g	16,8 g	1,55 g	486
Corn	76,85 g	3,86 g	6,93 g	Minimum	361
Lemon	9,32 g	0,3 g	1,1 g	2,5 g	29
Lentils	60,08 g	1,06 g	25,8 g	2,03 g	353

Astronaut Diet

Food	Carbs	Fats	Proteins	Sugars	Energy (Kcal) for 100 g
Chickpea	60,65 g	6,04 g	19,3 g	10,7 g	364
Chicken	5,3 g	2,5 g	20,1 g	Minimum	125
Trouts	Minimum	6,18 g	19,94 g	Minimum	141
Crickets	64,9 g	13,8 g	64,9 g	Minimum	534
Waxworms	3,70 g	32,8 g	52,7 g	Minimum	649
Dried Milk	51,98 g	Minimum	36,16 g	51,98 g	362
Canned Meat	Minimum	3,30 g	19,0 g	Minimum	111
Canned Tuna	Minimum	8,21 g	29,13 g	Minimum	198
Hen's Egg	1,1 g	11 g	13 g	Minimum	145
Black Chocolate	52,42 g	38,31 g	6,12 g	36,71 g	579

-Green: Cultivated on Mars surface;

-Yellow: Farmed on Mars surface;

-Red: Brought from Earth.

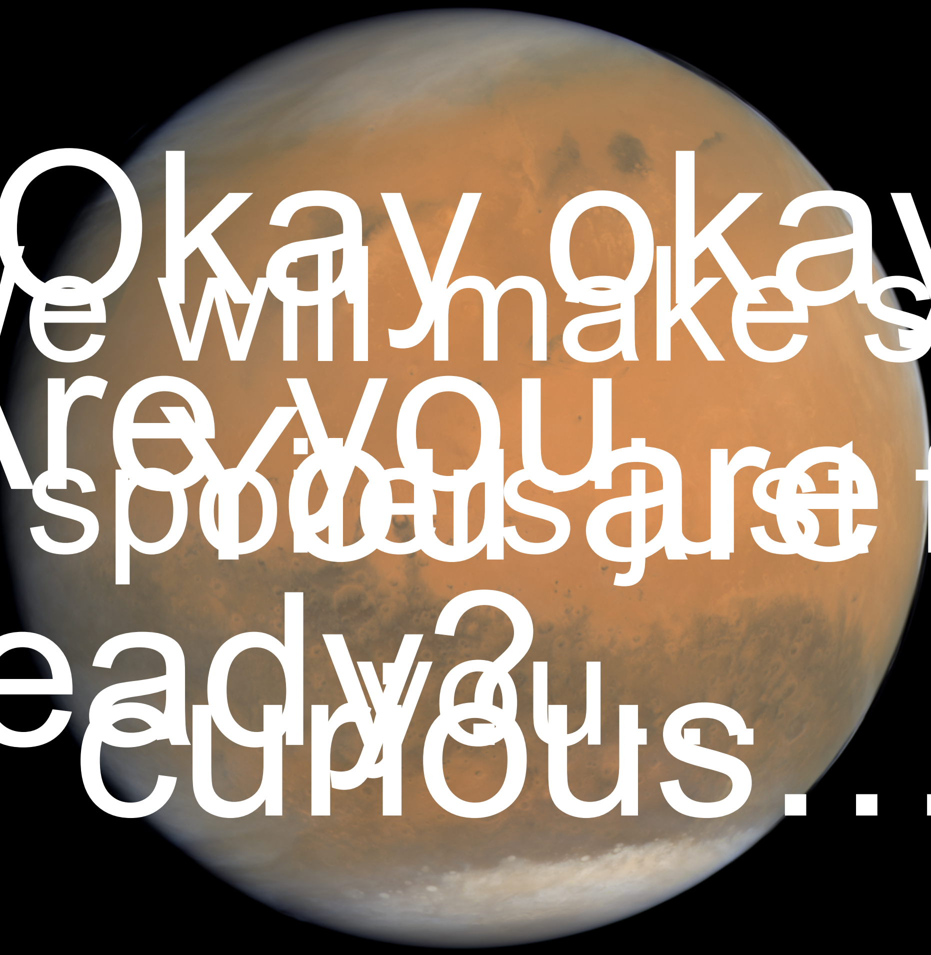
Mission Three

This is another story . . .

course!

Thank

Mission Three



Okay okay…
Are you ready?

- We will make some spoilers just for you curious…

Mission Three

Lift off!!

3 2 1

Mission Three

Fecundated cow's egg

cel

And make them evolve in the

biolab

Mission Three

To create a real Martian farm

Laertiadae Classis

Thanksgivings

- We want to thanks for their support and contribution:

- **Riccardo Stevanato** for his help in the model realization;
- **Andrea Segoni, Maurizio Gioi, Sabina Tomasicchio** for his help in the 3D modeling of the Ithaca Outpost;

And in the end

- Our teacher **Maura Bruno** for her confidence and support.

Sources

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