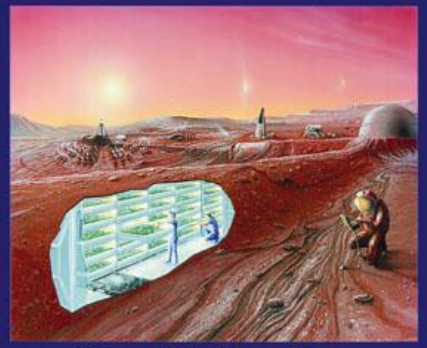
EDUCATIONAL PROGRAM
"SCHOOL SPACE AGENCY"

Advanced Life Support Technology

Terrestrial Benefit

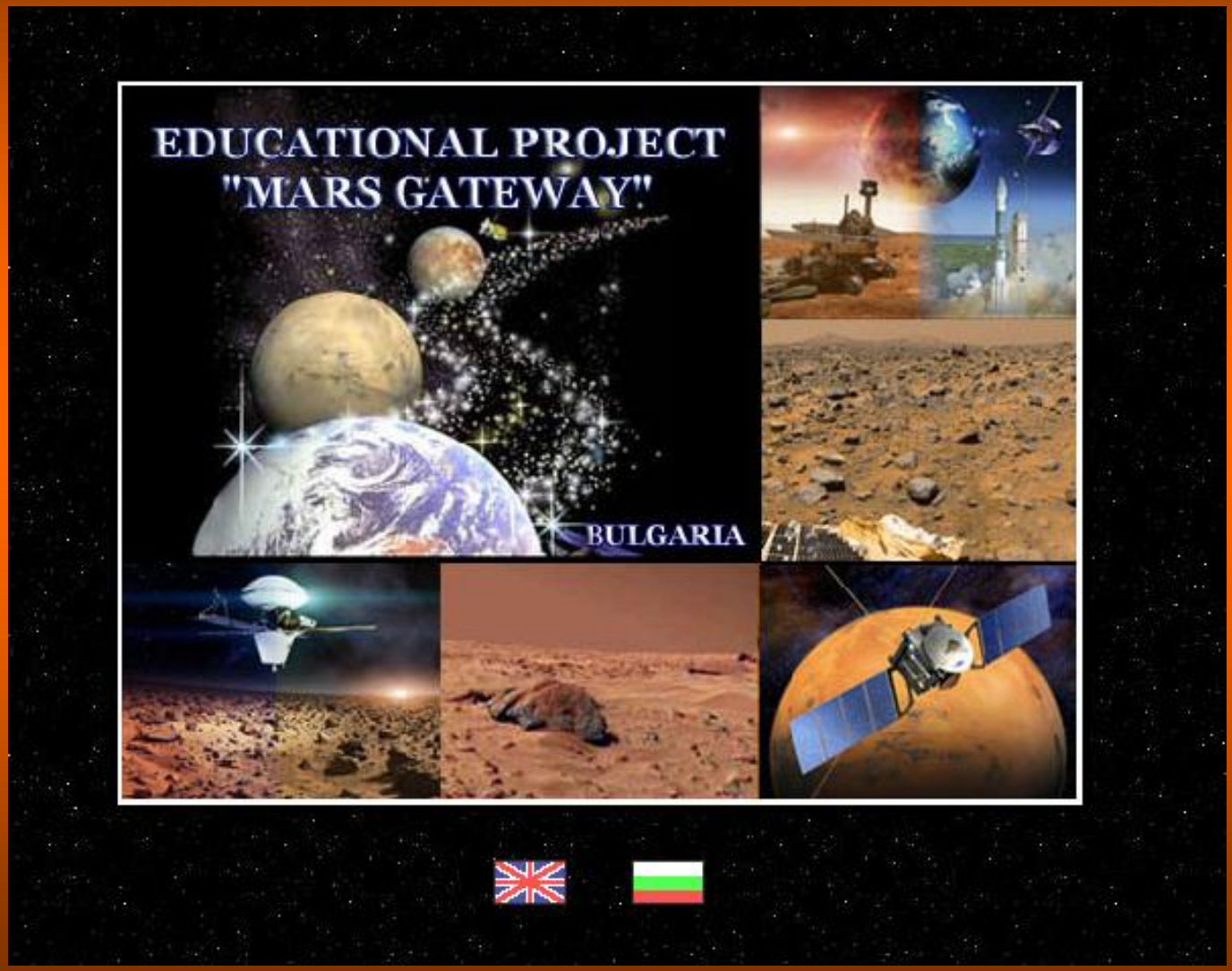
Space Station Application

Lunar Exploration



Mars Exploration

MARTIAN BASE "MARS GATEWAY"



INTERDISCIPLINARY PROJECT

Why on Mars?

Mars is a planet – secret, a planet-dream for many generations!

Mars is the planet from where the human civilization will head towards its exciting and overwhelming way to the edges of the Solar system and distant stars.

The aim of the project Mars Gateway is the development and the creation of a model of a Martian Base.

The project has been made by a team of students from the Professional high school in building, architecture and geodesy, Varna, Bulgaria

Teacher in physics and astronomy: Katya Mareva
Author and Scientific consultant: Veselka Radeva
Astronomical Observatory, Varna, Bulgaria

STAGES OF WORK OVER THE PROJECT:

First stage (January-May 2004):

- Getting acquainted to the information about the planet and the physics characteristics and conditions
- Determination of the aims of the expedition
- Determination of the people who will be in the base: number, professions, sex

- Determination of the length of the expedition
- Choice of place of the base
- Form and design of the base
- Two versions for construction of mars walkers
- Live-supporting systems, circulation of water and air
- Creation of biosphere (selection of the types of plants and food)
- Creation of an active web page of the project

- Problems with the nourishment of the astronauts
- Problems with the landing of the modules for living
- Types and ways of receiving energy
- Selection of materials for the building of the base, taking into consideration the conditions on Mars
- Ways of landing on the planet

Second stage

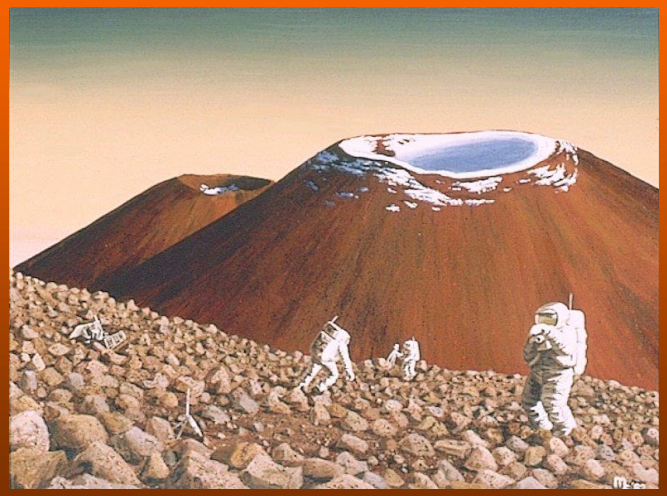
(May – September 2004)

Creation of a computer virtual model of the base, informative model in Internet and a real model of the Martian surface with the infrastructure of the base and the mars walkers.

Third stage

(September – December 2004)

Development of a packet of scientific and research projects for exploration of Mars using the Martian base



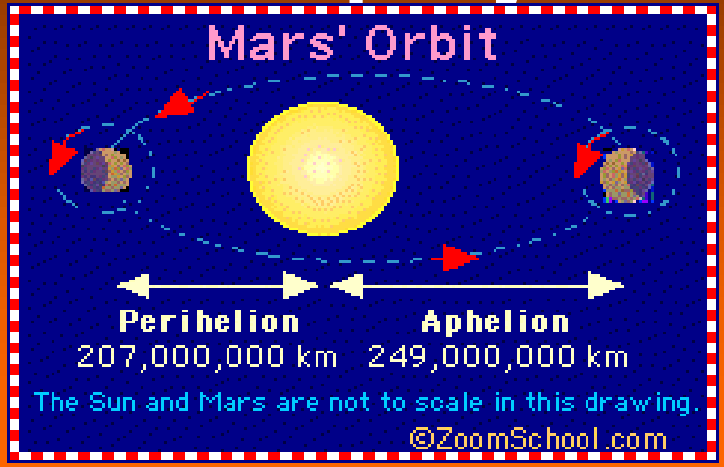
First stage:

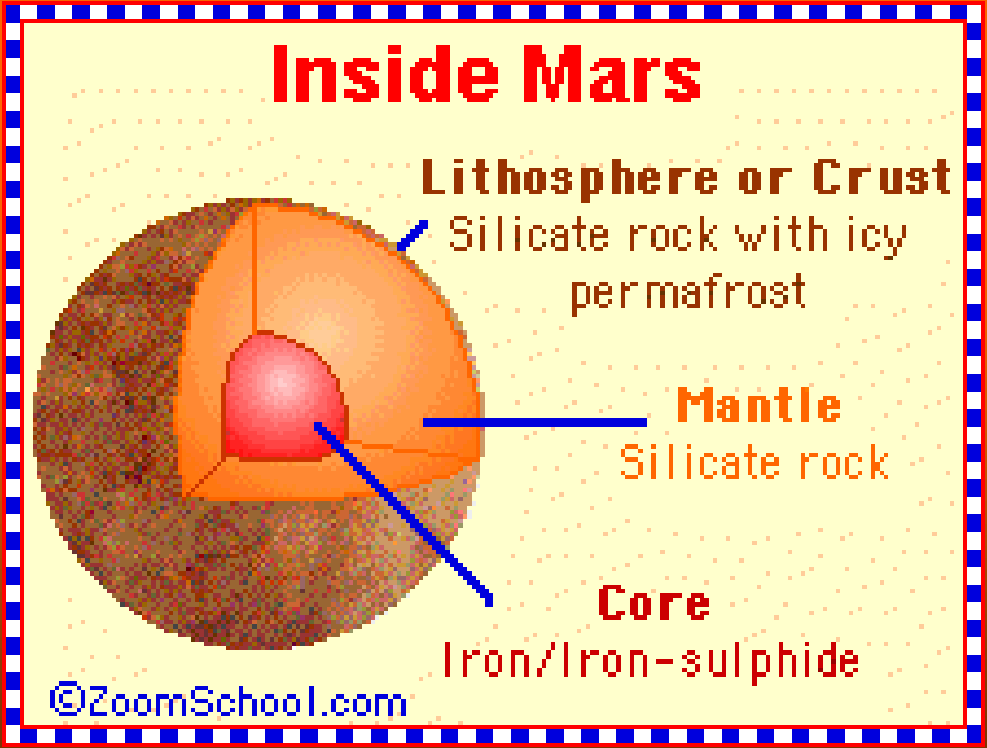
Results from the work over the project:

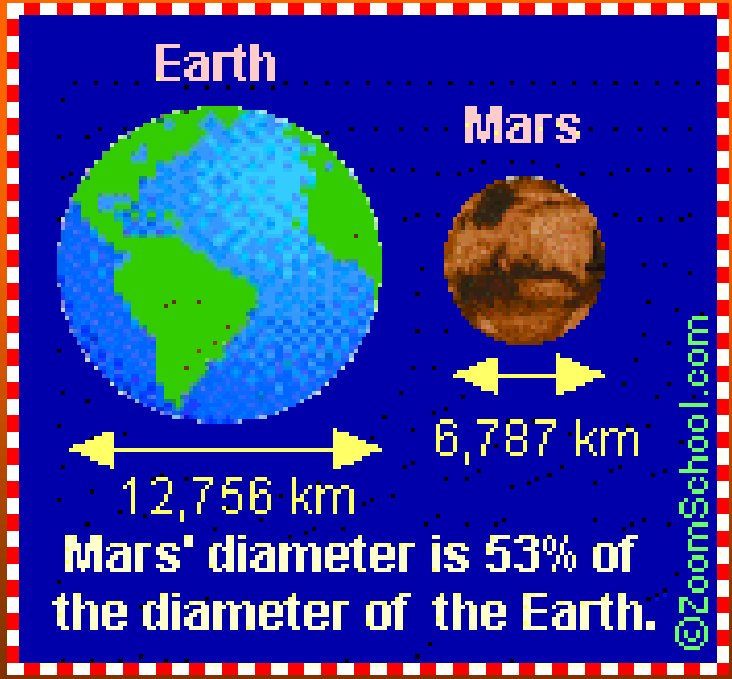
Field: astronomy

Creation of a portrait of Mars

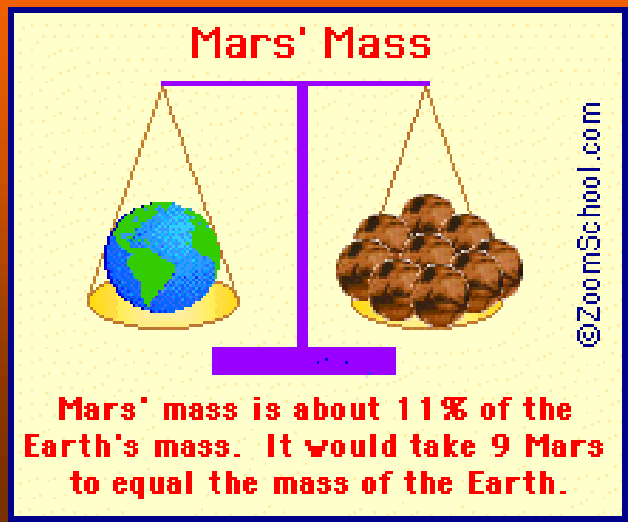
Physics characteristics of the planet





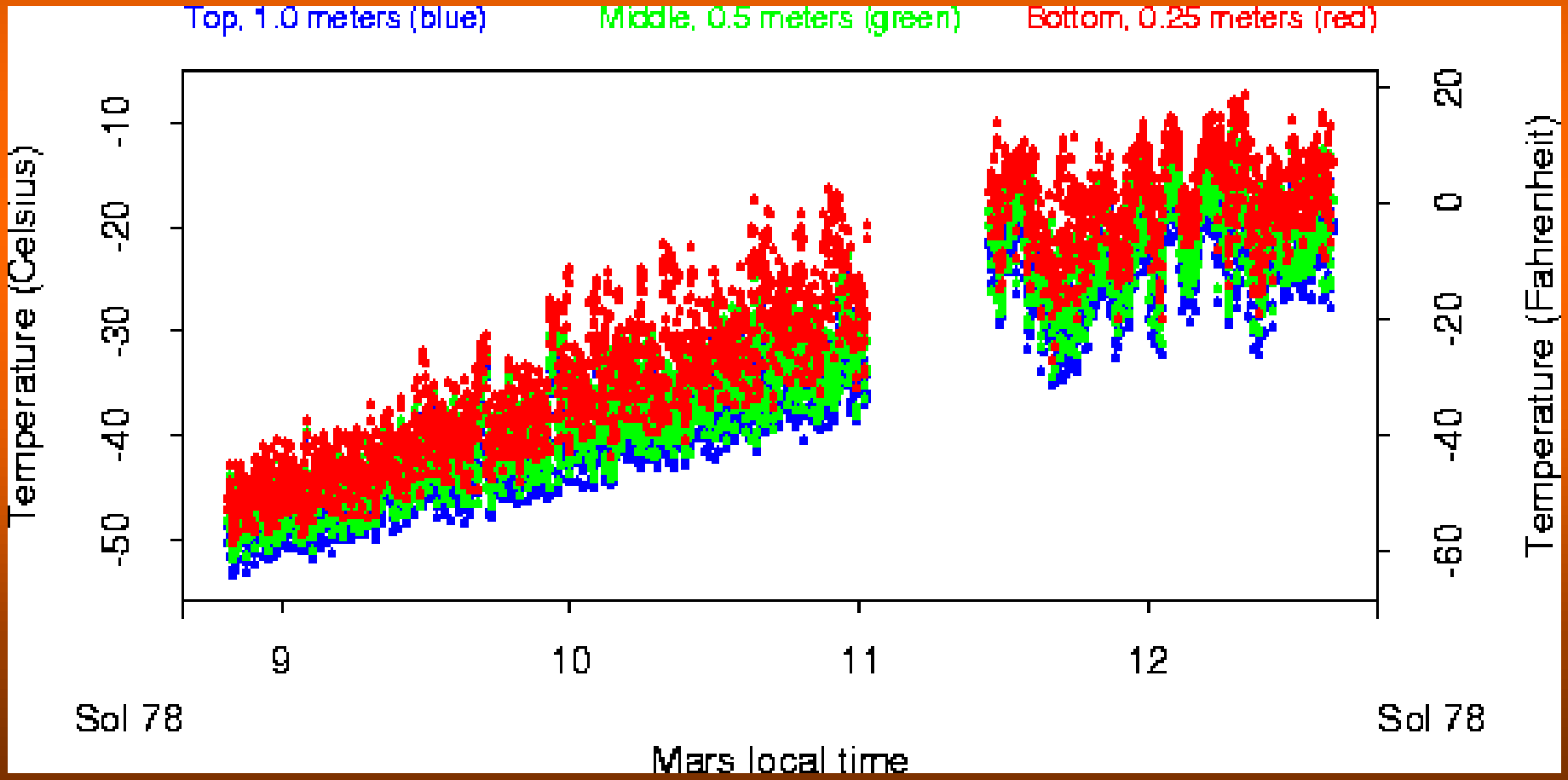


Average distance between Mars and the Sun: 2.2793664 x 108 km (1.523662 A.U.)
Perihelion: 2.066 x 108 km (1.381 A.U.)
Aphelion : 2.492 x 108 km (1.666 A.U.)
Equatorial radius: 3.397 x 103 km
Equatorial diameter: 2.1344 x 104 km
Volume:1.6314 X 1011 km3
Mass:6.4185 x 1023 kg
Density: 3.94 g/cm3
Area: 1.441 x 108 km2
Equatorial gravity of the surface:3.693 m/s2
For comparison: If the Earth is 60kg, then Mars would be 23 kg
First space speed: 5.02 km/s
For comparison: On the Earth it is 7.9 km/s
Length of the day: 1.026 earth days or 24.62 hours
For comparison: The day on the Earth is 23.934 hours
Length of the year: 1.8807 Earth years or 686.93 Earth days
Own orbital speed: 24,130.9 m/s
For comparison: 0.810 x Earth
Eccentricity of the orbit: .0934
For comparison: 5.59 x Earth
Angle between the orbit and the ecliptic: 1.8 degrees
Length of the orbit: 1.3669 x 109 km

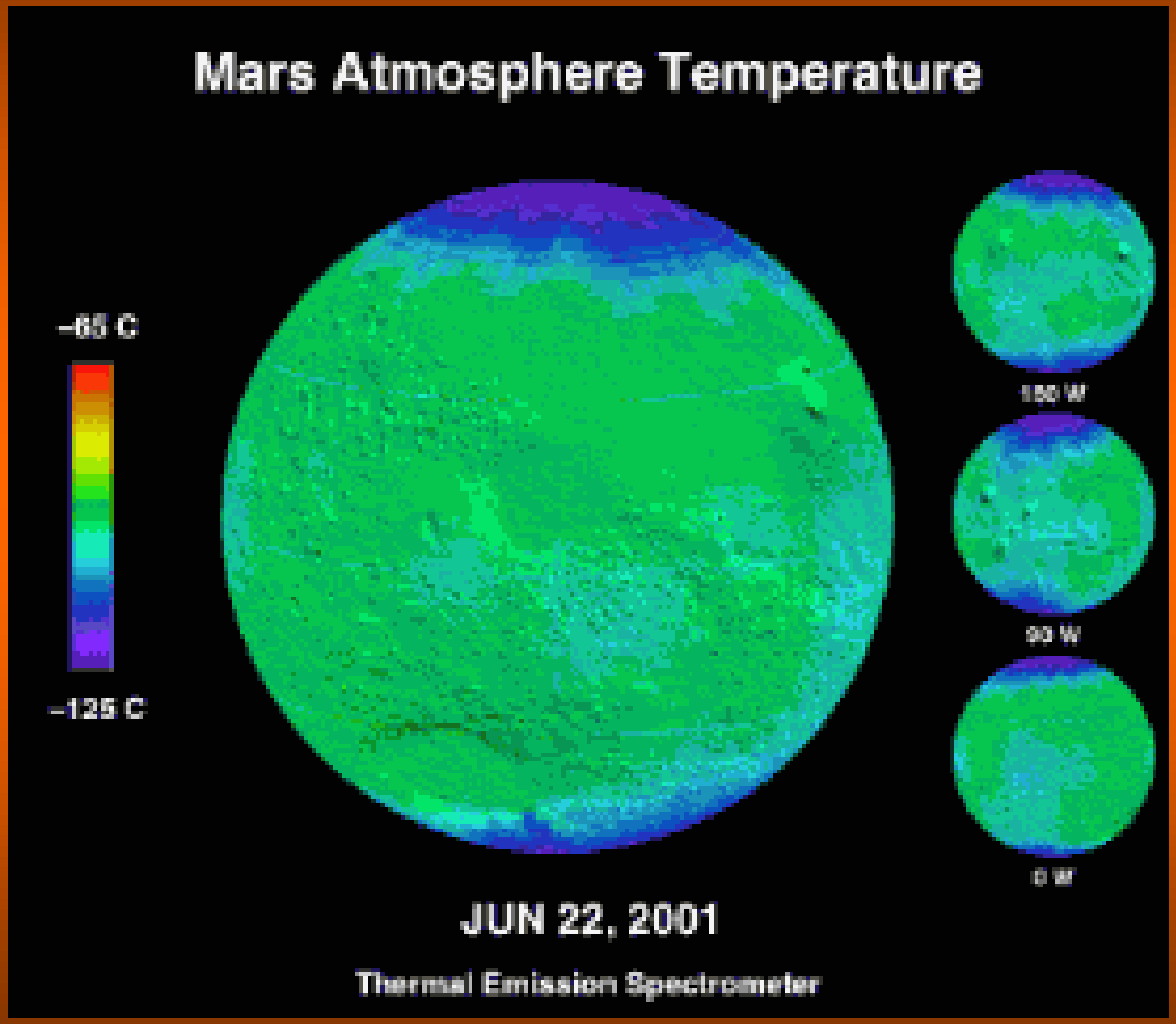


Temperature and pressure

The average measured temperature on Mars is -63º C with maximum temperature of 20ºC and minimum temperature of -140ºC.
The barometric pressure varies in the various fields.

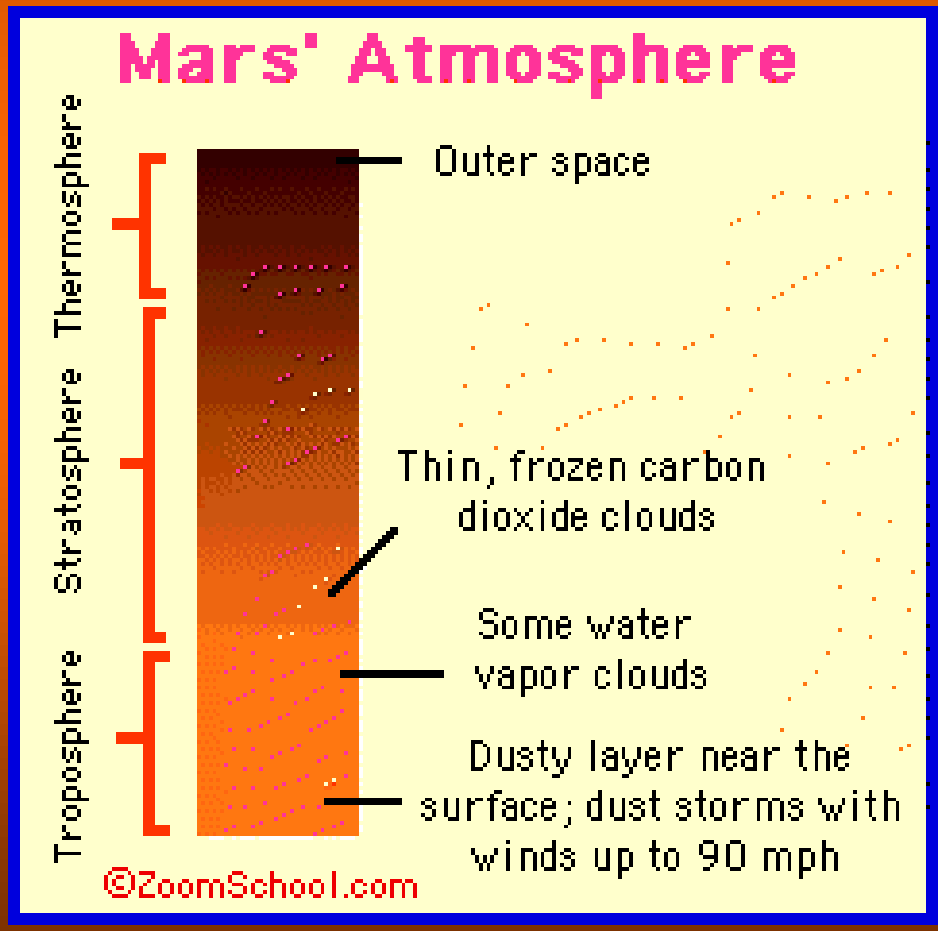


Interval of temperature for the period 22 June 2001 - 8 July 2001



Characteristics of the atmosphere

The atmosphere on Mars is very different from the atmosphere on the Earth.
It contains mainly carbon dioxide and small quantities of gases.
The sixth most common compounds in the atmosphere are :
Carbon dioxide (CO2): 95.32%
Nitrogen(N2): 2.7%
Argon (Ar): 1.6%
Oxygen(O2): 0.13%
Water (H2O): 0.03%
Neon (Ne): 0.00025



Characteristics of the surface of Mars

The dark spots on the surface of Mars, the so called "maria" or "albedo features," have been compared to large lakes, oceans or plants. Space probes from 1970 shoed that these are large fields of rocks and dust. Sometimes the dust storms carry away the dust, and as a result there are seasonal and years-long changes in the dark areas on the surface of this planet. These fields become very dark during the early Martian spring, as if "a dark wave" has gone down from the thawing polar caps towards the equator.

The dark and light fields change their albedo (the ability to reflect) and color contrast of the planet every day. The seasonal changes on Mars are usually predictable, but the years-long changes are not.

Characteristic of the surface on Mars

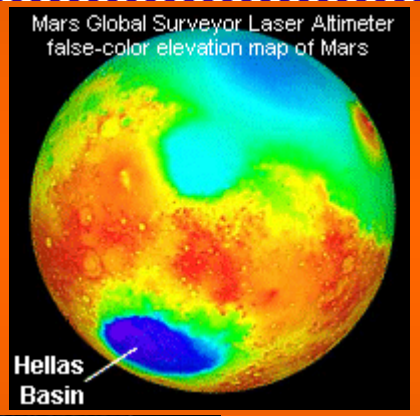
Among the planets from Earth type, Mars is the next planet after the Earth that has multifarious and interesting surface:

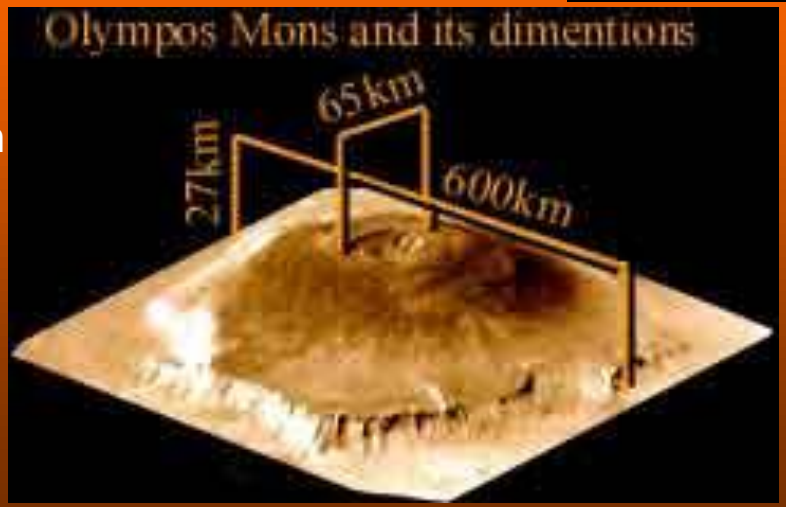
-Olympus Mons is a dead volcano. It is the largest mountain in the Solar system – its height is 24 km above the surrounding field. Its base is more than 500 km wide and it is surrounded by a rock that is 6 km high.

-- Tharsis: a large high area on the surface of Mars that is 4000km wide and 10 km high.

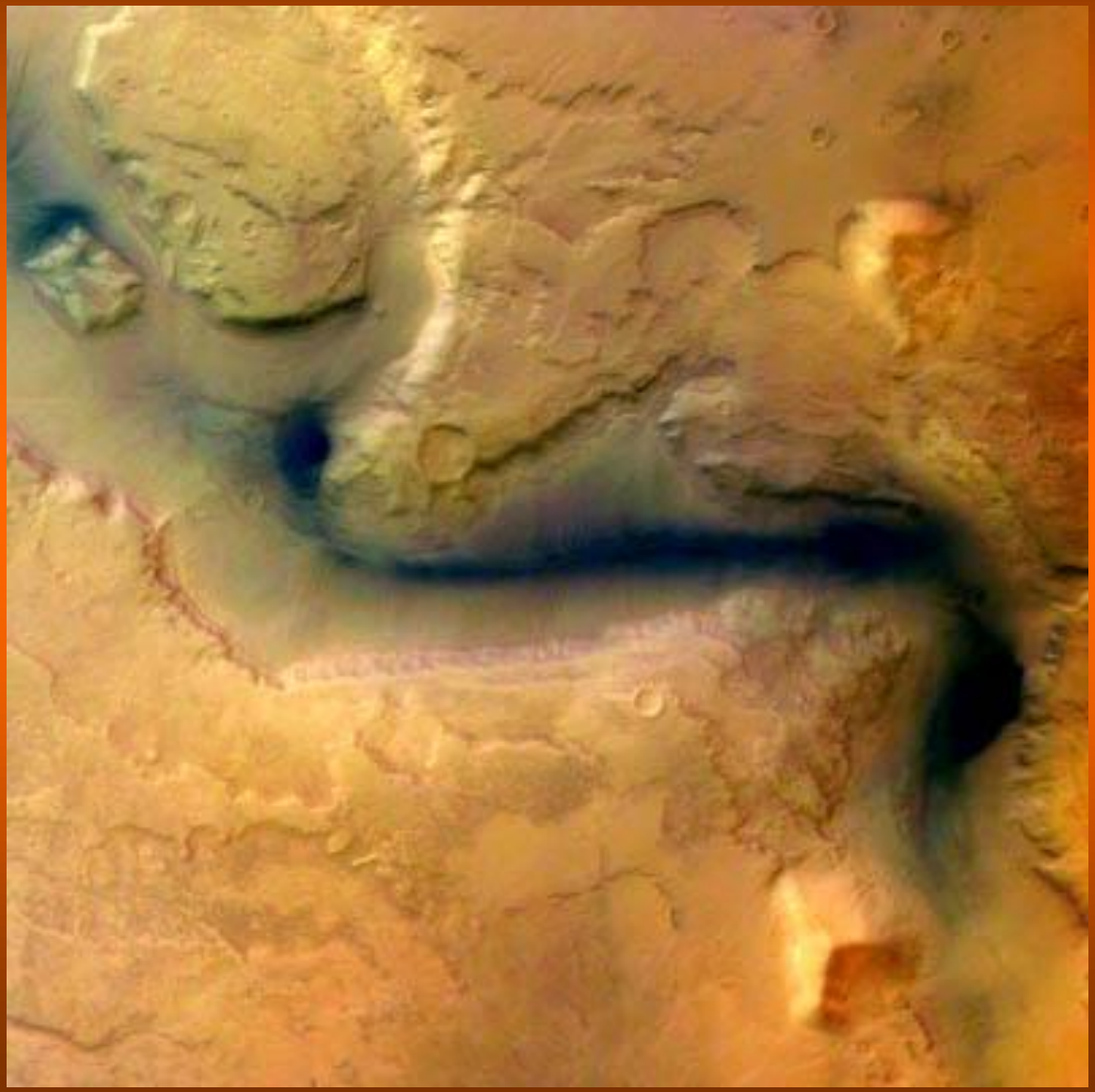
-- Valles Marineris: a system of canyons that is 4000km long and from 2 to 7 km deep.

- Hellas Planitia: a crater in the southern hemisphere – around 6 km deep and its diameter is 2000km .

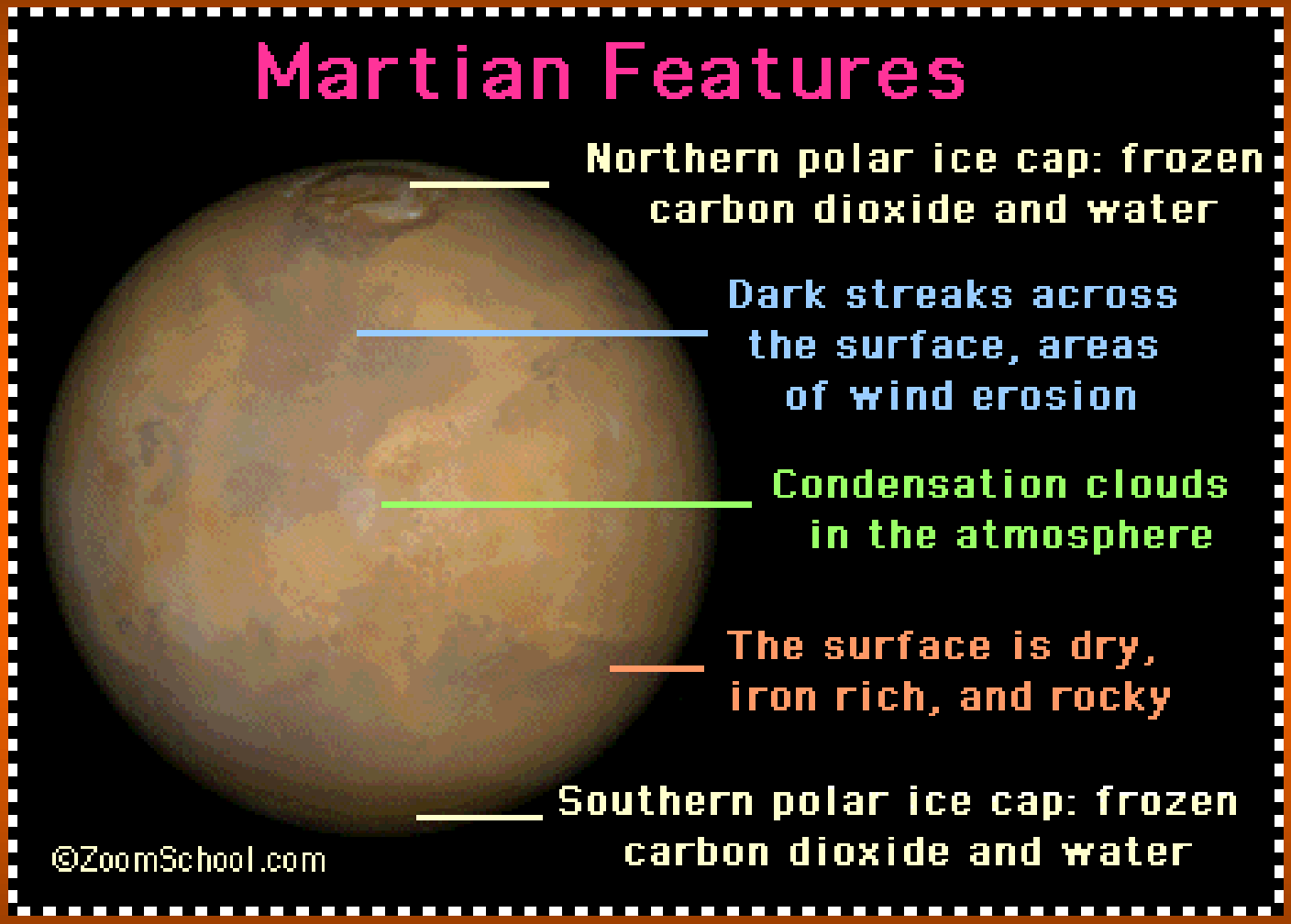




You can see all forms of the Martian relief at www.solarviews.com

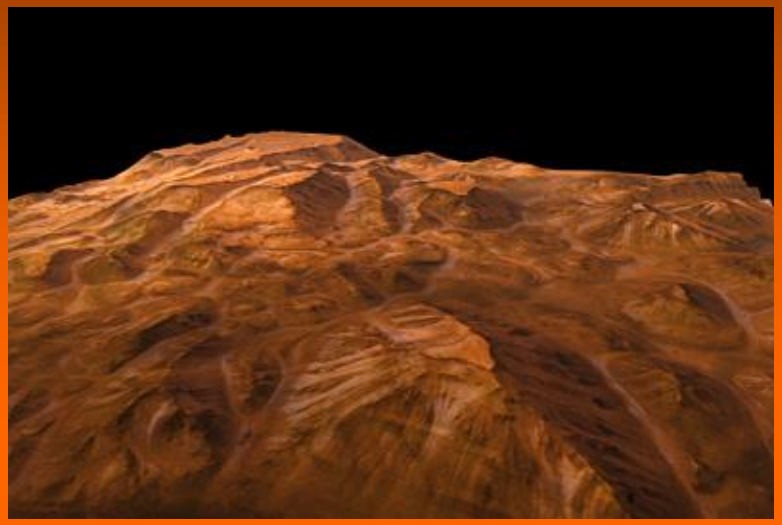


Relief of the surface



You can see all forms of the Martian relief at www.solarviews.com

Types of Martian surface



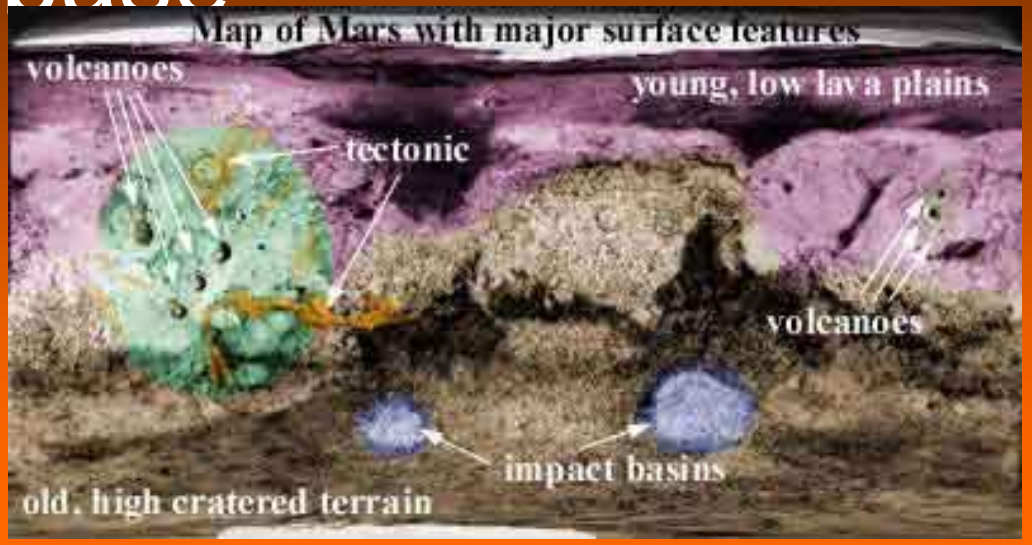
Photographic and visual observations of Mars

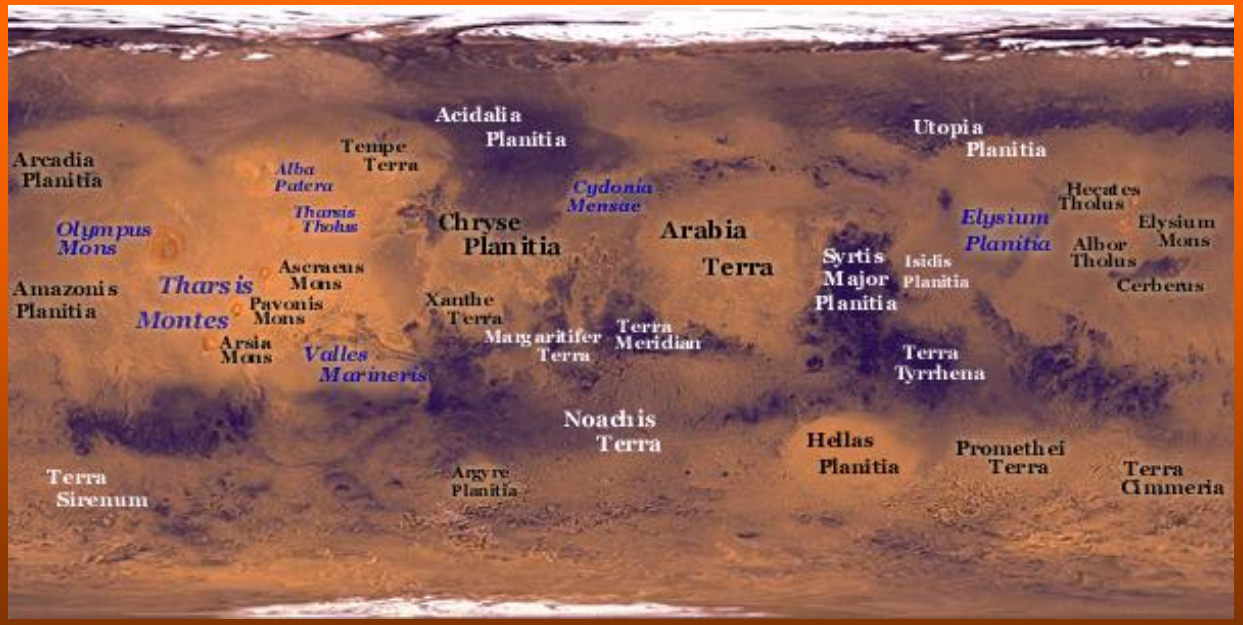
We used observations of Mars made by students from the team, so that we got acquainted to the Martian surface and we managed to select the position of the base

The photos have been made with a 20 cm telescope – Newton system and a web camera

Selection of the position of the base

1. Tarsis Montes
2. Arabia Terra





Requirements and consideration for the successful landing of the spaceship:

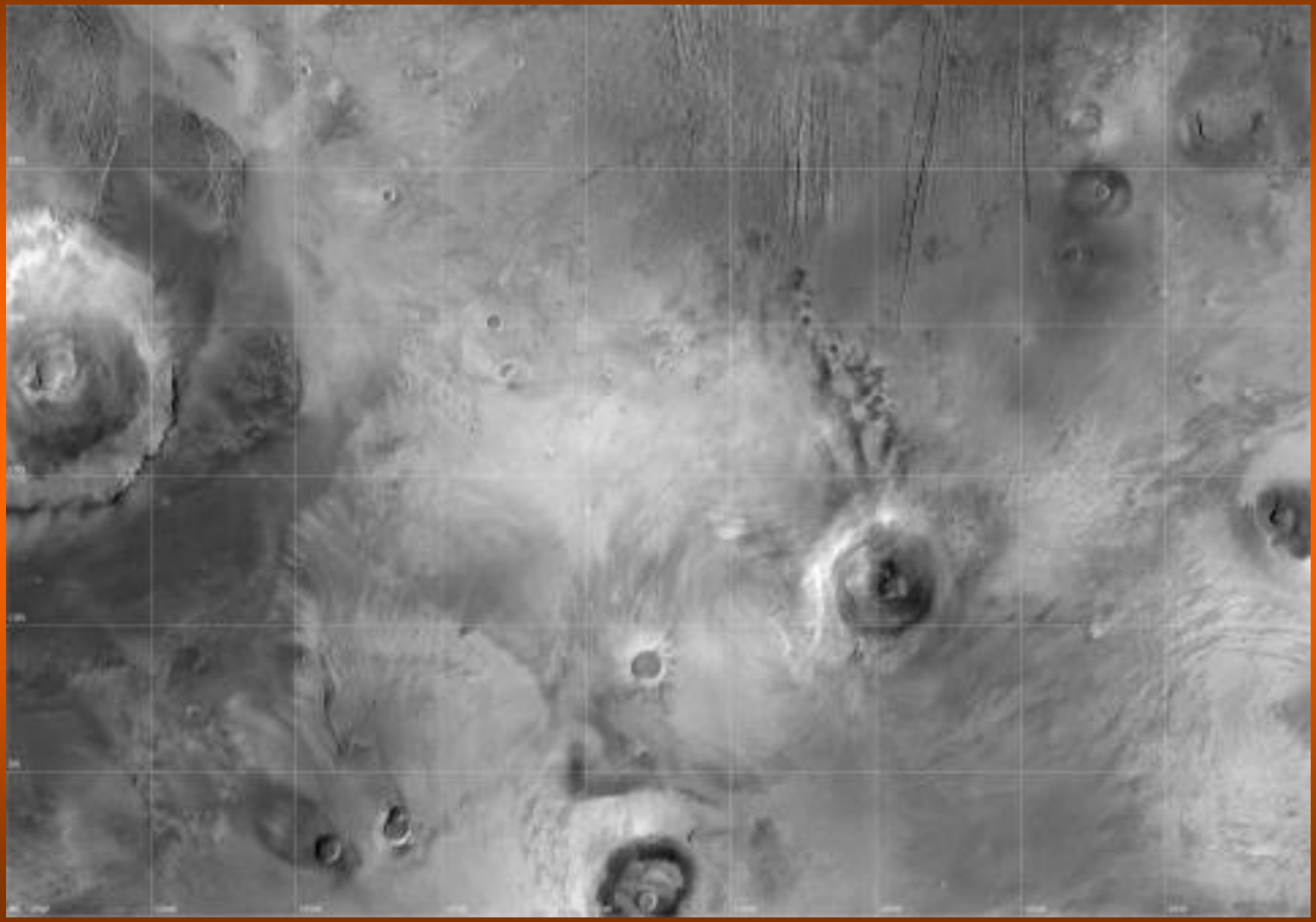
No deep craters

No volcanoes

No high mountains

Relatively flat surface

Preferred position for the base



Main goals of the expedition: scientific, research and colonization of Mars

People in the expedition – 10 astronauts:

Commander, navigator, doctor – female

Engineer – telecommunications, mechanic – male

Navigator, chemist - male

Doctor, astrobiologist – female

Astrobilogist, chemist - female

Engineer in energy , computer systems - male

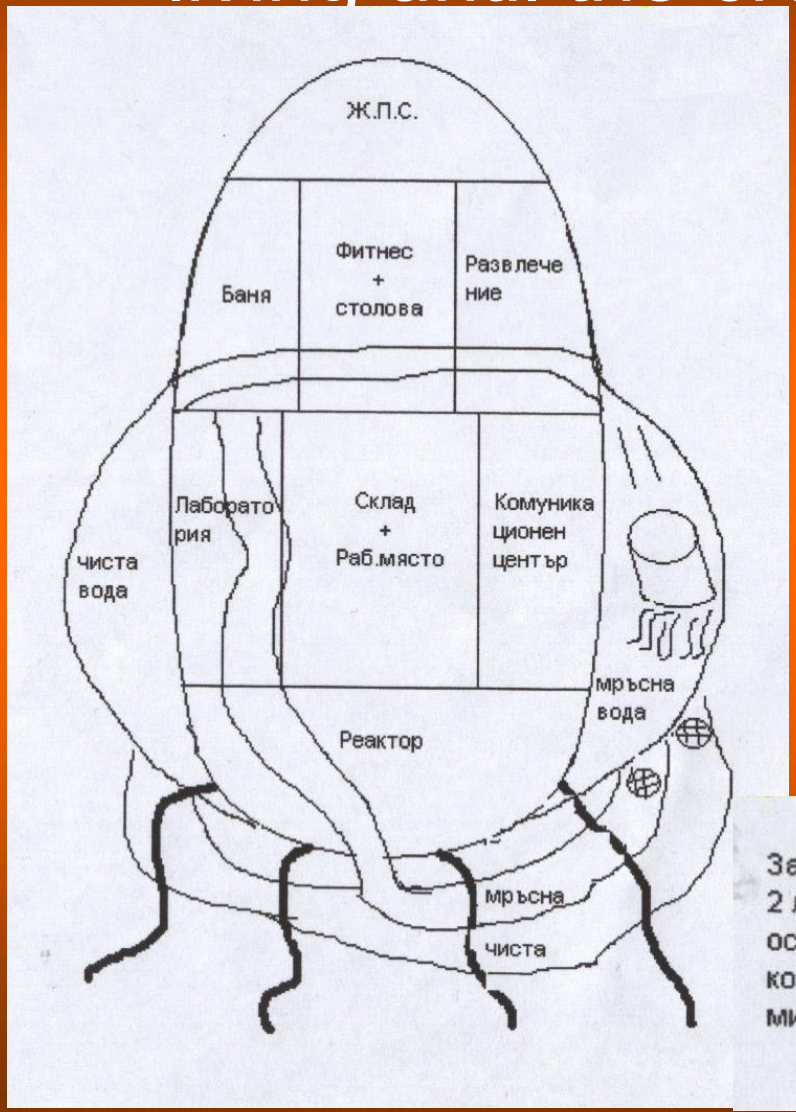
Engineer – aviation equipment , mechanic - male

Engineer – navigator, geologist - male

Astrobiologist, navigator - female

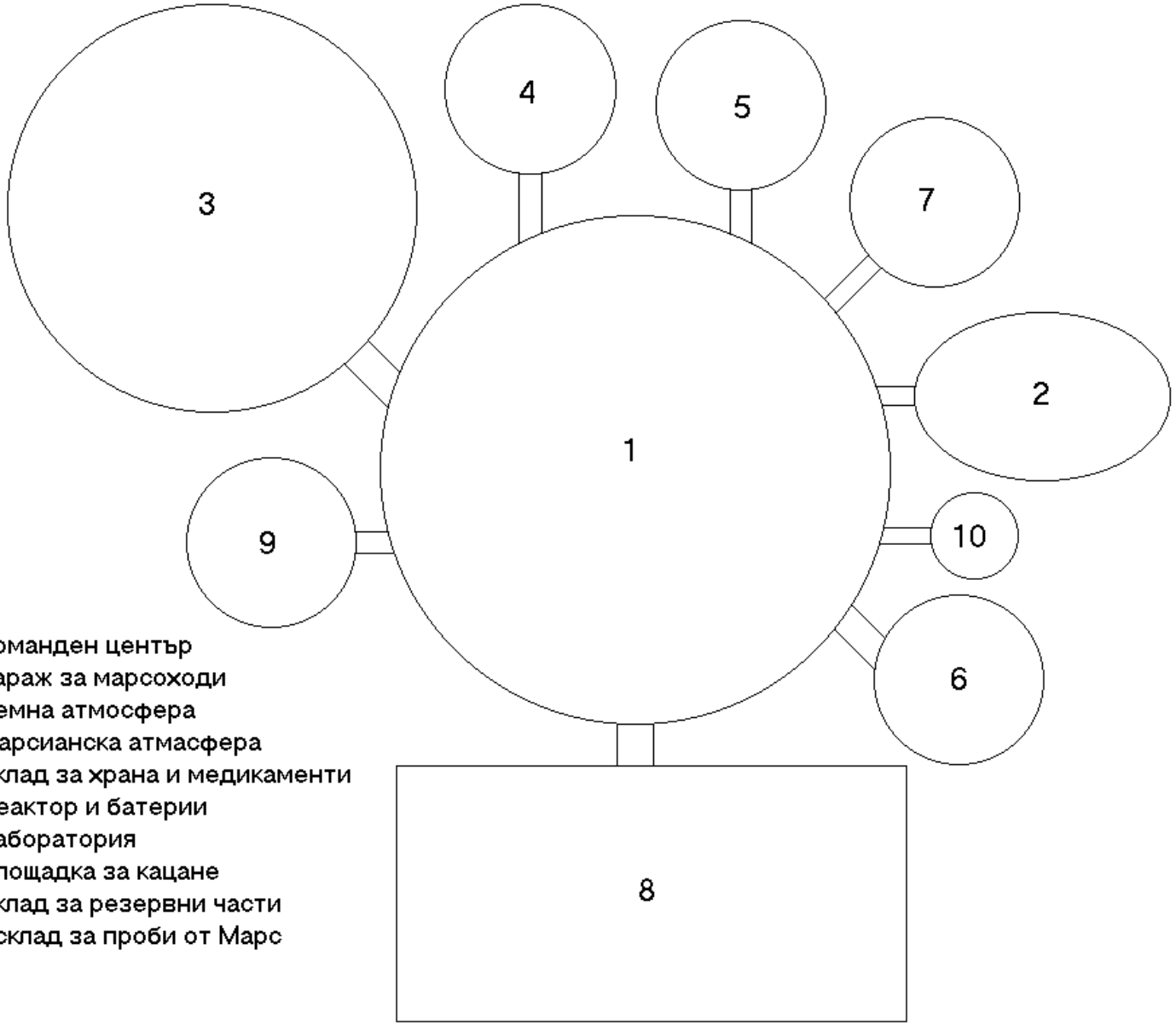
Physicist – engineer, chemist - fem

Construction of a module for landing and living until the creation of the main base



За три години за двама души в модулът са необходими 9 000 литра вода. 2 литра на ден x 1095 дни x 2 души в модула ~ 4 500 литра вода за пиене,а останалата вода е за миене, като не е включена вода за къпане , защото космонавтите си измиват кожата с някакви препарати.Тази вода , която е з миене ще се преработва отделно като се използва режима на циркулацията

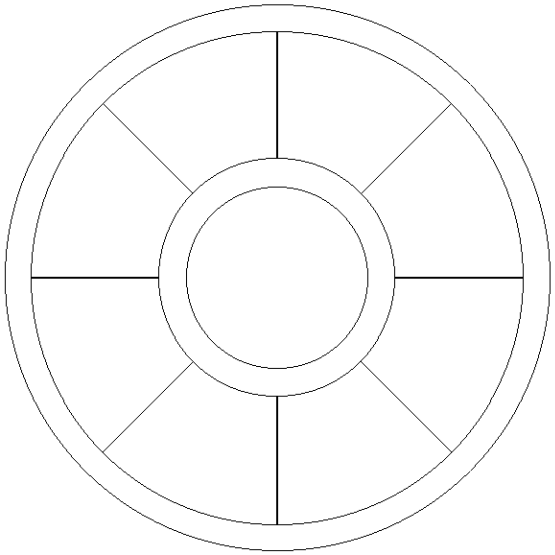
The Martian base



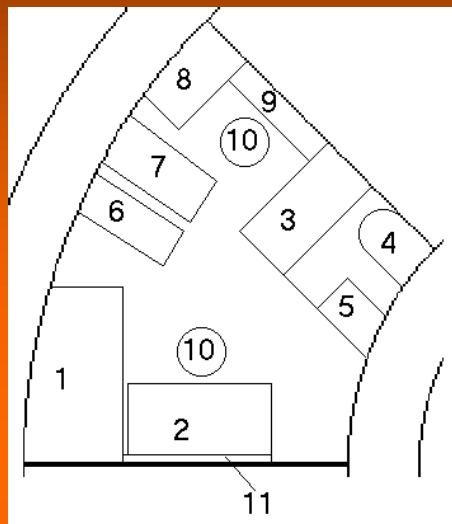
Model of the structure of the command center

The main base

Command center

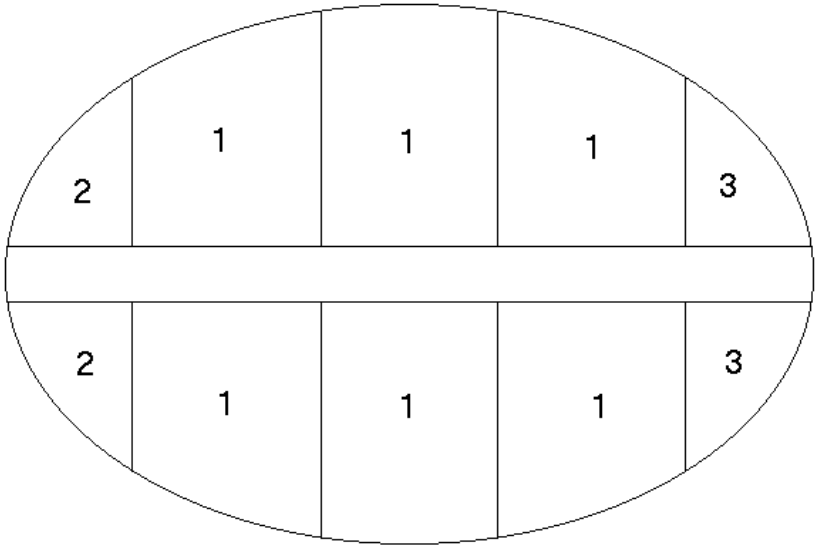


Personal module of each astronaut



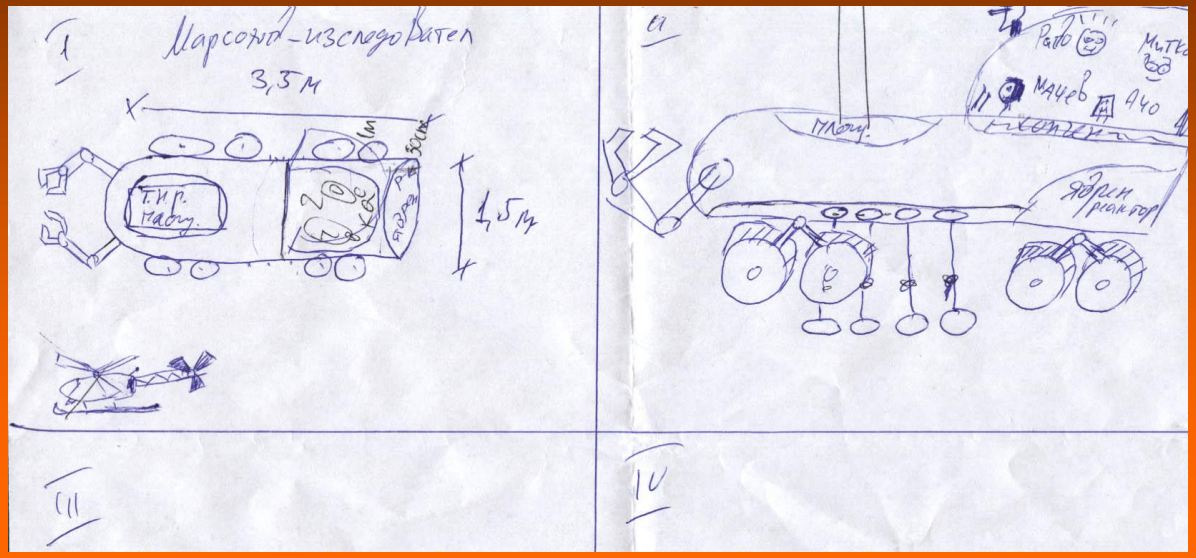
1-легло
2-бюро
3-душ
4-тоалетна
5-мивка и аптечка
6-фитнес-колело
7-фитнес-б.пътека
8-шкаф за храна
9-маса
10-стол
11-плазмен монитор

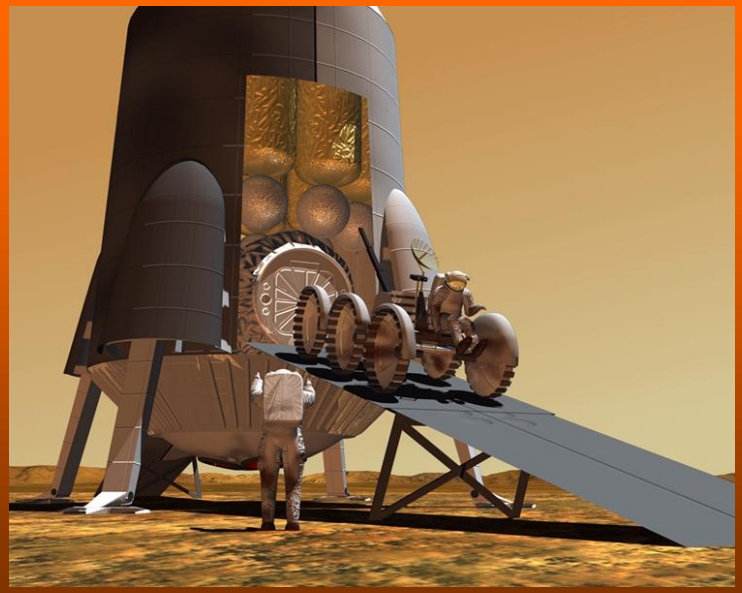
Help sector

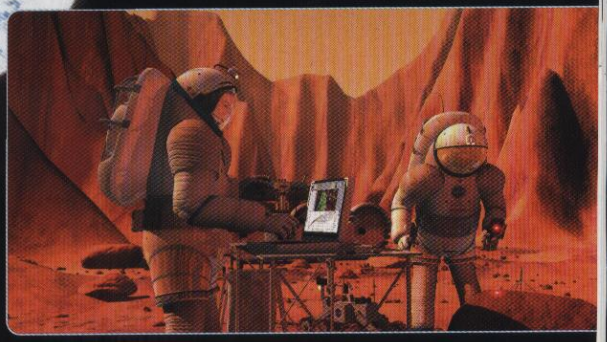


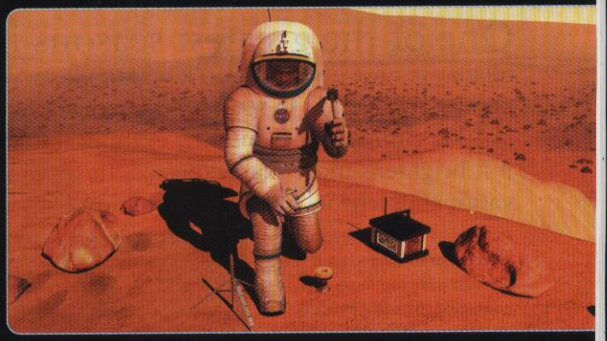
1-гараж за марсоходи
2-помещение за резервни части
3-помещение за гориво

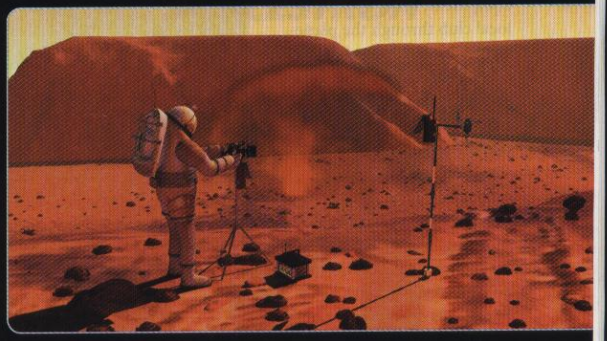
Mars walkers

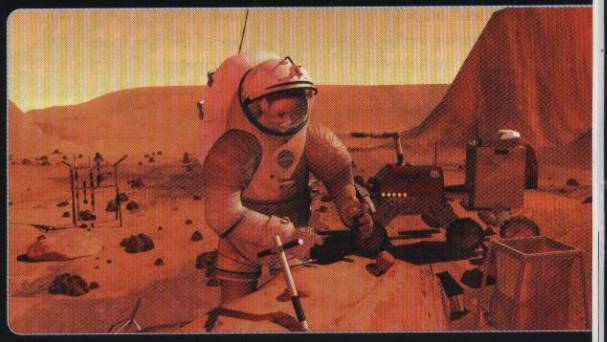


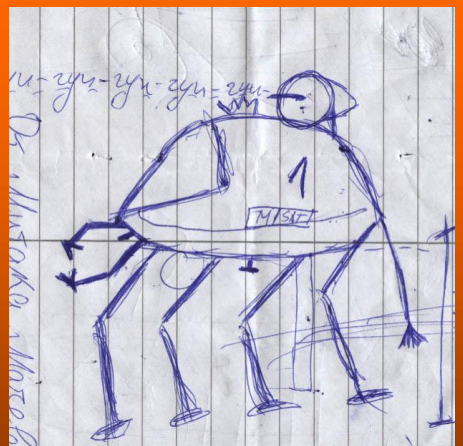








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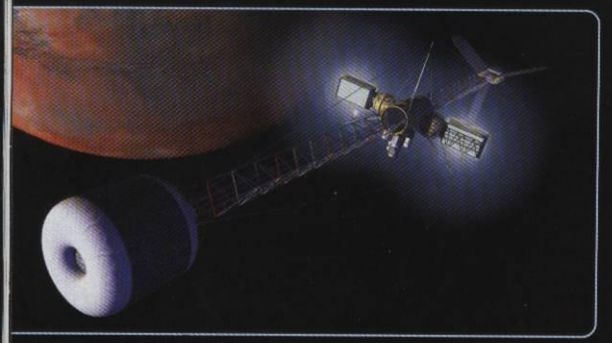
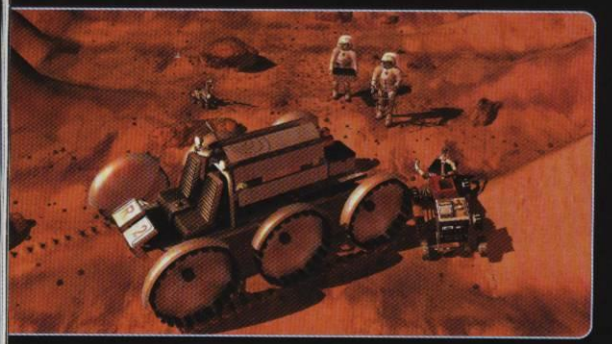
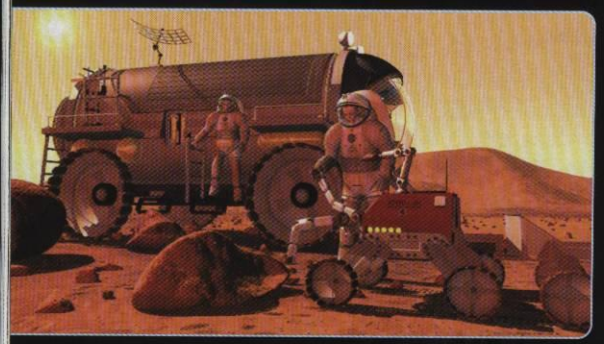
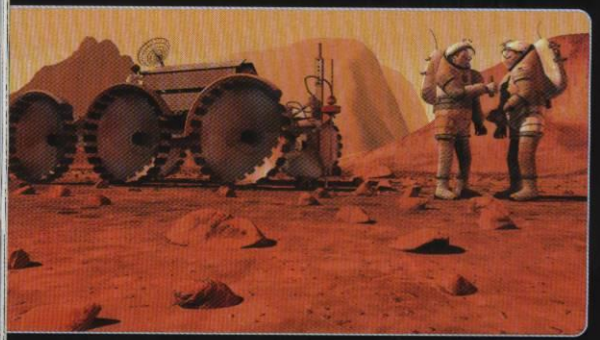
МИСТ





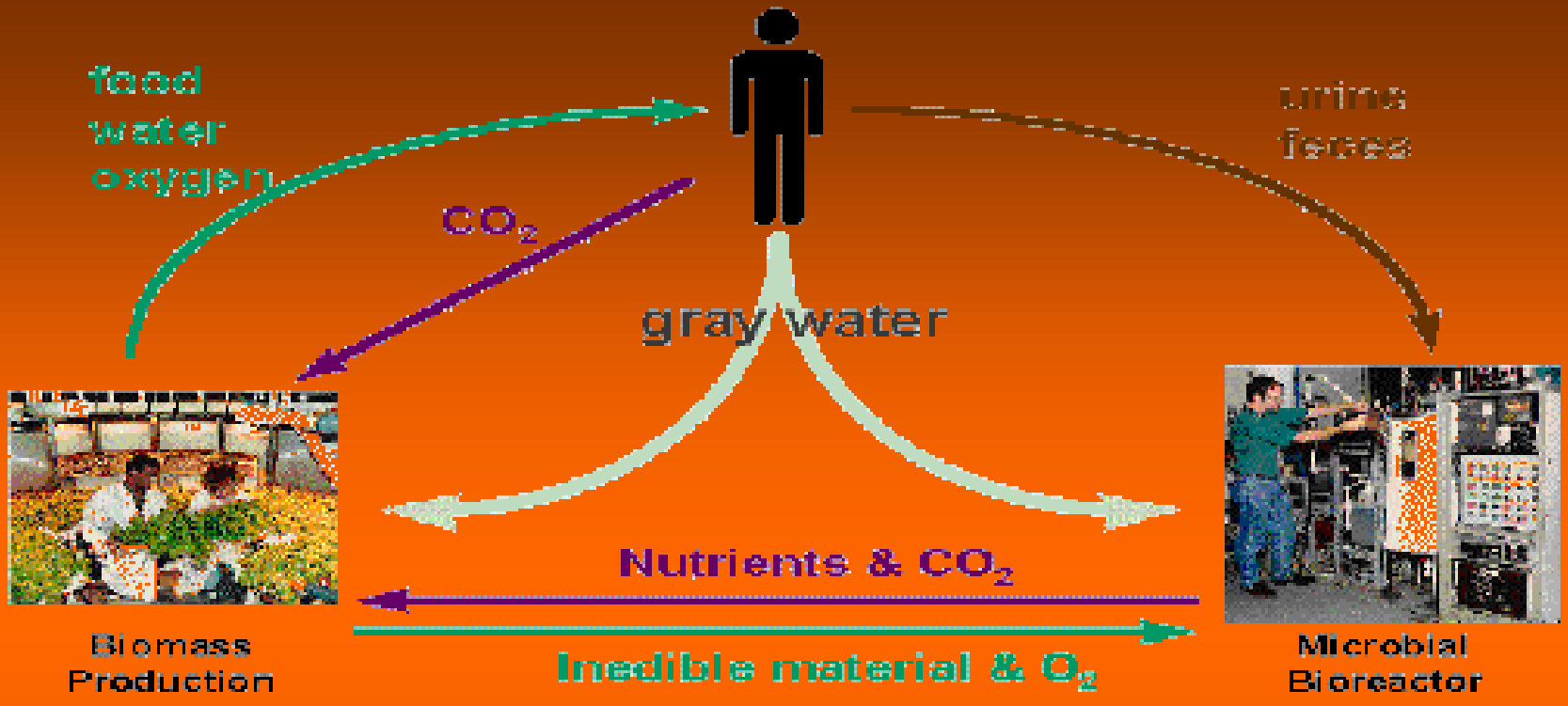




Field BIOLOGY

BIOSPHERE

In order to eat healthy food, the astronauts on Mars should have balanced menu that includes not only concentrated food but also fresh vegetables.
That is why a greenhouse with conditions close to those on Earth should be created.
We predict the cultivation of the following plants:



- **The three main elements of the bioregeneretic system for life support are – humans, plants and microbes**
- **The diagram shows how each of these elements supports the rest, creating a close ecologic system.**

Peas grown in MKS for a period of 6 weeks ready for cultivation of peas second generation.

The cultivation of this type of small peas is very important because a small biosphere with peas will support life in the space ship or in the module. Peas give oxygen and food for the astronauts. The ability of such plants to propagate is the key to long travelings in space.

Version for dwarfs – peas, ready for living in space and on other planets.

ISS006E45035

ISS006E45082

TOMATOES

Chemical content – tomatoes contain around 5,5% dry substances. They contain: sugars 3,5%(mainly glucose, then fructose and saccharose), pectinous substances 0,3%, cellulose 0,7%, proteins 0,9%,fats 0,2%, organic acids 0,45% (citric, malic, amber, raspberry, quinine) , minerals 0,5%(potassium, phosphorus, calcium, magnesium, sodium, iron). There are also vitamins:C(25mg%),B1(0,06mg%),B2(0,04mg%), K(0,60mg%),E(0,85mg%), carotene(0,4-0,6mg%).
The content of calories in tomatoes is 88 kJ in 100g.

NECCESARRY-120 strikes
Distance between lines: 75см
Distance between the strikes: 30см

CUCUMBERS

CHEMICAL CONTENT-Cucumbers contain from 3,3 to 5,1% dry substances (the types in the greenhouses contain 3,2-3,6%). Cucumbers contain: sugars 1,1-2,5%,pectin substances 0,35%,cellulose 0,40%,pentosines0,20%,farina 0,10%,protein substances 0,60%, fats 0,2%,organic acids 0,1%, mineral substances 0,5%(potassium, calcium, sodium, iron, magnesium). There are vitamins:C(12mg%),B1(0,02mg%),B2(0,035mg%),PP(0,20mg%),carotene (0,02-0,08mg%). The content of calories in cucumbers is 42-63 kJ for 100g.

NECESSARY - 70 STRIKES
Distance between the strikes-15см
Distance between the lines - 50см

PEPPER

CHEMICAL CONTENT-The content of dry substance in pepper varies in different types: in pepper with large fruits it is 7,71%, while in pepper with small fruits it is 9,88%.There are : sugars 3,7-7,4%, cellulose 1,2-1,4%, proteins 1-1,5%,fats 0,3-0,5%,organic acids 0,10%,mineral substances 0,5-0,7%(potassium, calcium, magnesium, sodium, iron). There are vitamins: C(110-196mg%),B1(0,06mg%),B2(0,05mg%),PP(0,33mg%),E(0,65mg%),carotene(0,5-2mg%), P and other.

The content of calories in pepper is from 109 to 130 kJ in 100 g.

NECESSARY -100 STRIKES
Distance between lines-30см
Distance between strikes-30см

LETTUCE

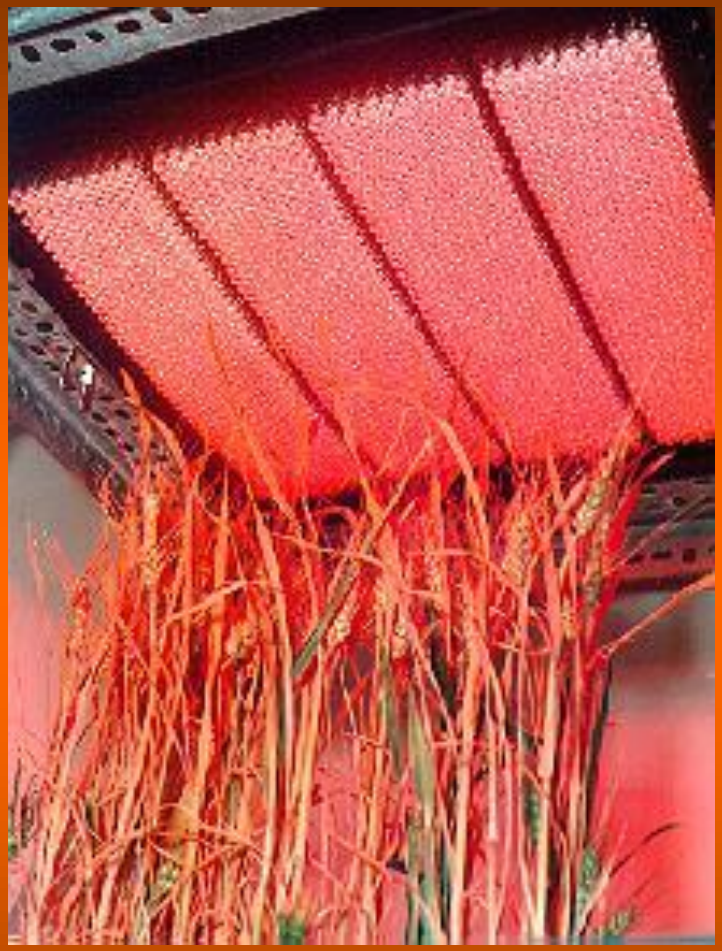
CHEMICAL CONTENT-Lettuce contains 2,5-5,9% dry substances. There are: sugars 0,5-1,7%, cellulose 0,6-0,8%,proteins 1,2-2%, fats 0,4%,organic acids 0,1%,mineral substances 0,9-1% (potassium, calcium, phosphorus, sodium, iron, oxalics) There are vitamins: C(18-20mg%),B1(0,07mg%),B2(0,09mg%),PP(0,35mg%),E(0,35mg%) ,carotene (1,70mg%).
The content of calories in lettuces is 75 kJ in 100 g.

NECCESARY-100 STRIKES
Distance between lines-20см
Distance between strikes-20см

POTATOES

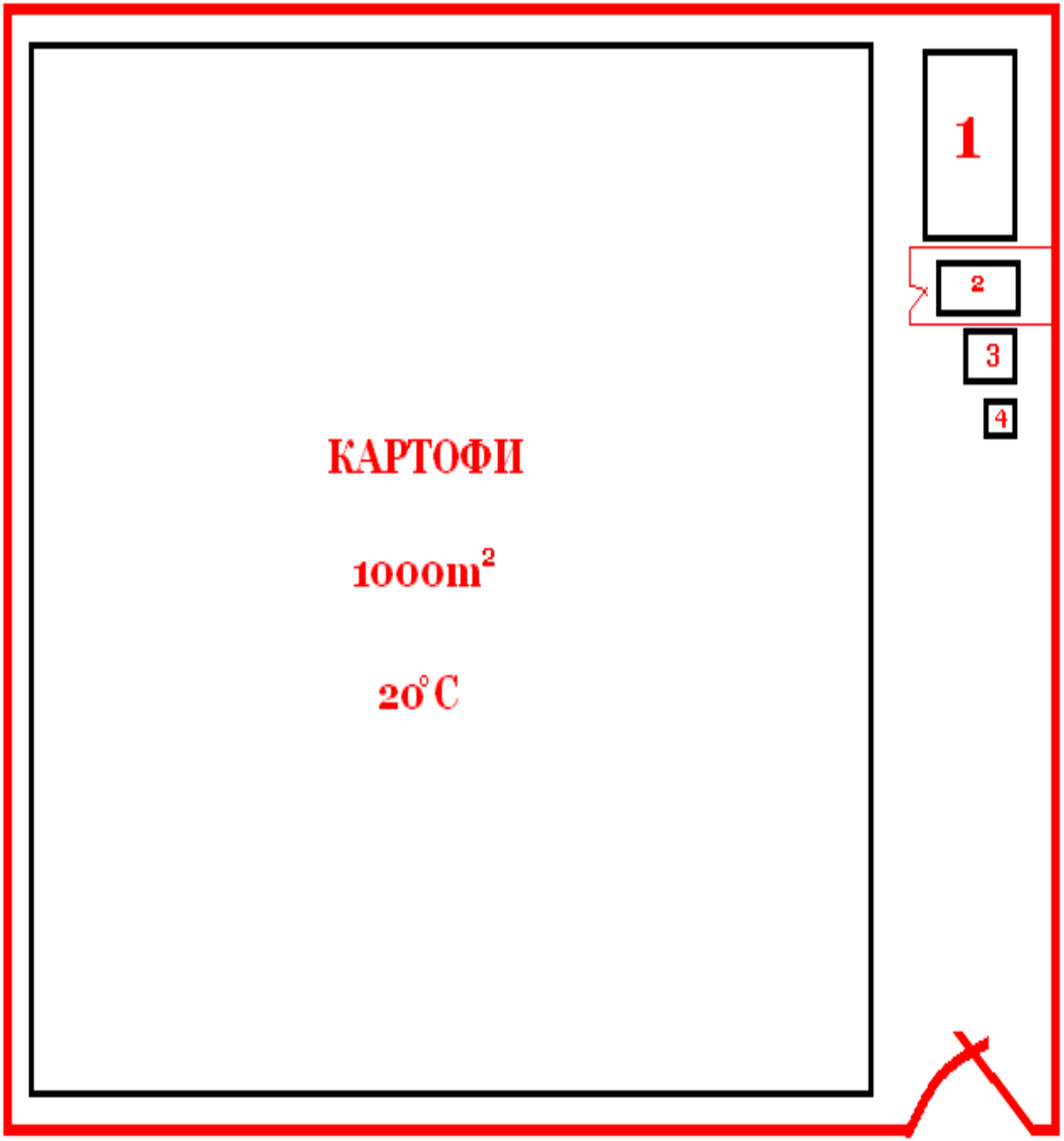
Herbaceous tuber-fruit-like plants from type Canine grapes from family potatoes.
CHEMICAL CONTENT-Potatoes contain from 17 to 33% dry substances (25% average). There are: farina 15-26%,sugars 1,5%,cellulose 0,5-1%, pectinous substances 0,58%, proteins 1,5-2%, fats 0,1%, organic acids 0,1-0,2%, substances with phenol-like nature(up to 0,1%), minerals 1,1%(potassium, phosphorous, magnesium, calcium, sodium, iron, etc). There are vitamins:C(18-21mg%),K(0,08mg%),B1(0,11mg%),B2(0,05mg%),PP(1,22mg%),E(0,1,mg%), carotene (0,02mg%).
The content of calories in potatoes is 373 kJ in 100 g.

Distance between strikes-20см
Distance between lines-50см



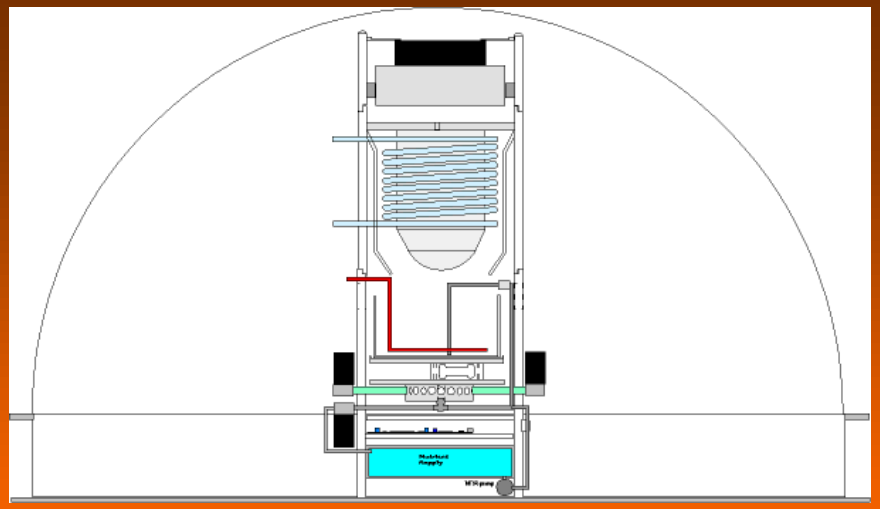
Because of the smaller quantity of light on Mars, additional lights will be necessary for the plants. The light will be from Light Emitting Diodes (LEDs) with frequency appropriate for the photosynthesis of plants. Similar light system that stimulates the growth of grain crops is shown on the picture.

SOY, THE SUBSTITUTE FOR MEAT, WILL BE THE MAIN FOOD IN THE MARTIAN BASE

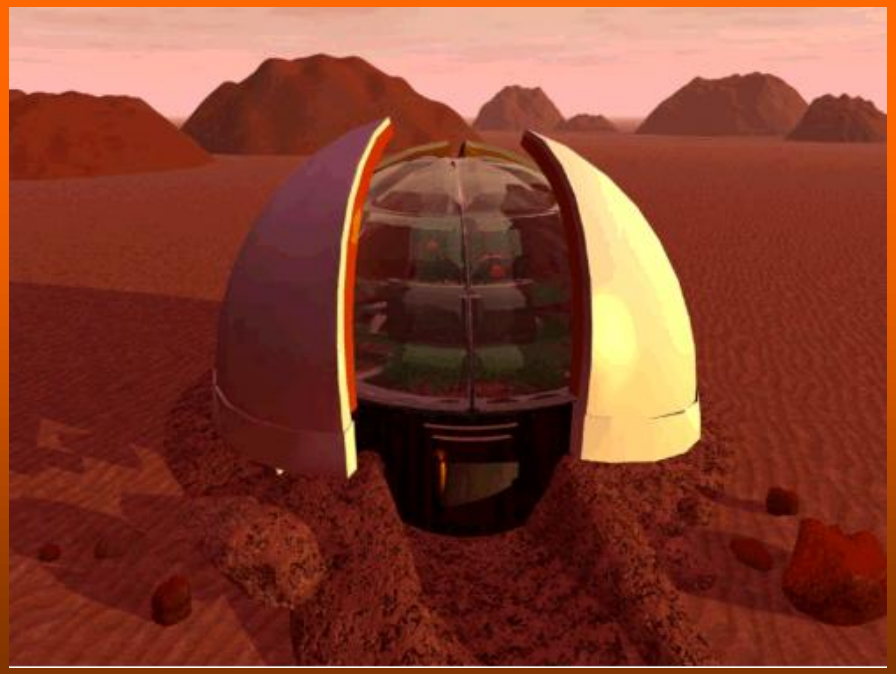


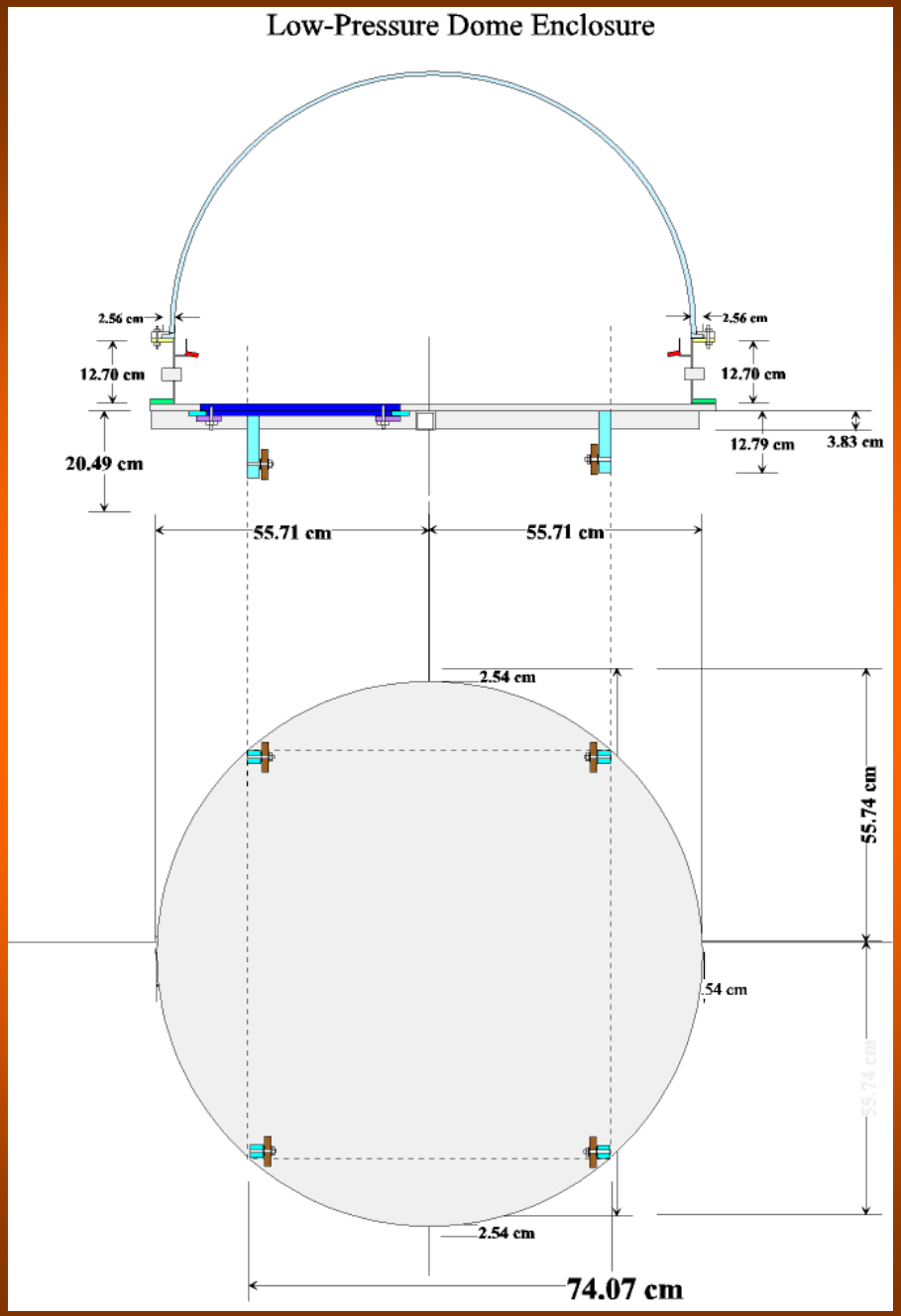
ЛЕГЕНДА

1. Домати-28,8m², 20°C
2. Краставици-5,25m², 25°C
3. Пипер-9m², 20°C
4. Маруля-4m², 20°C

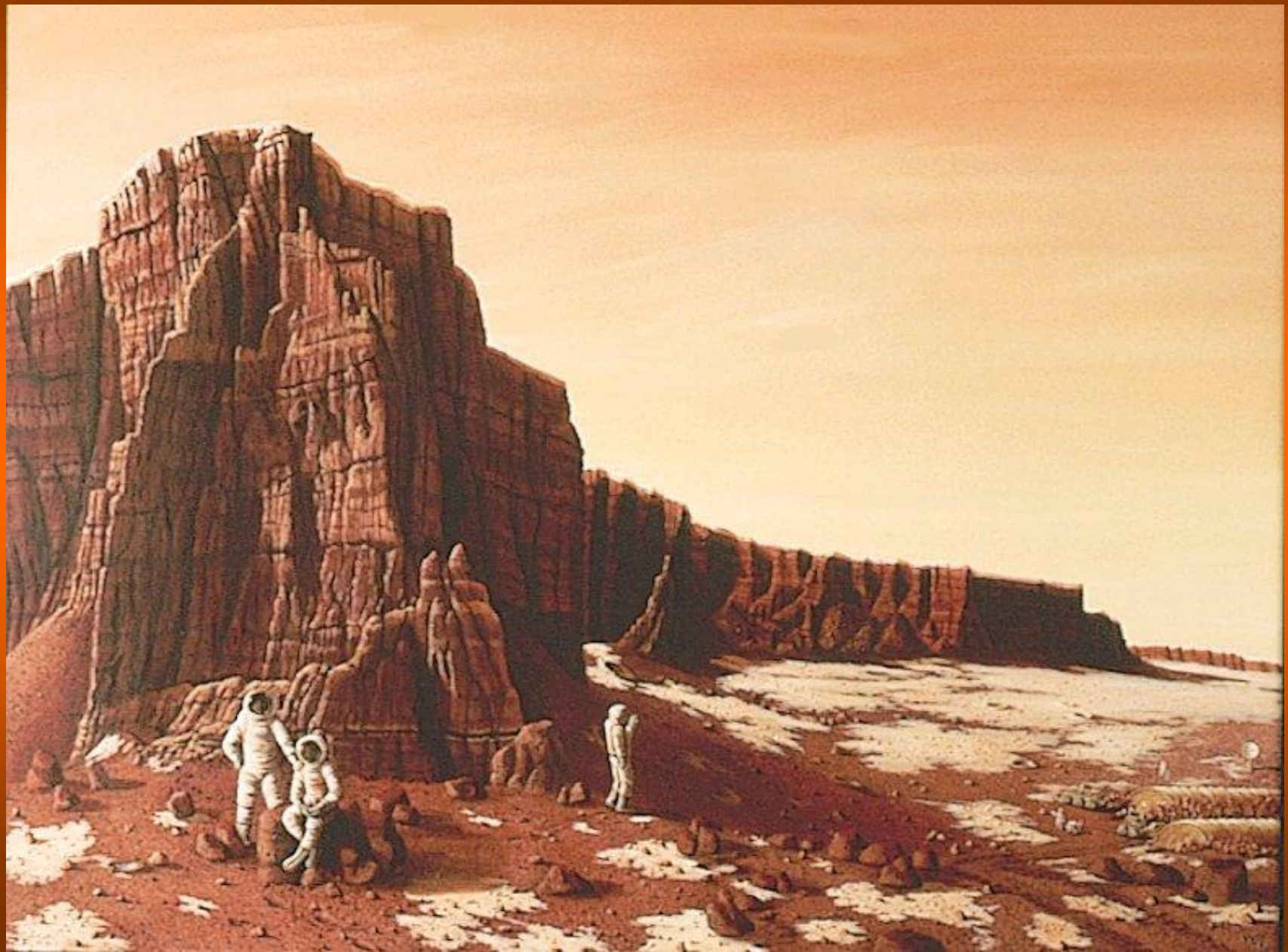


Biosphere -1



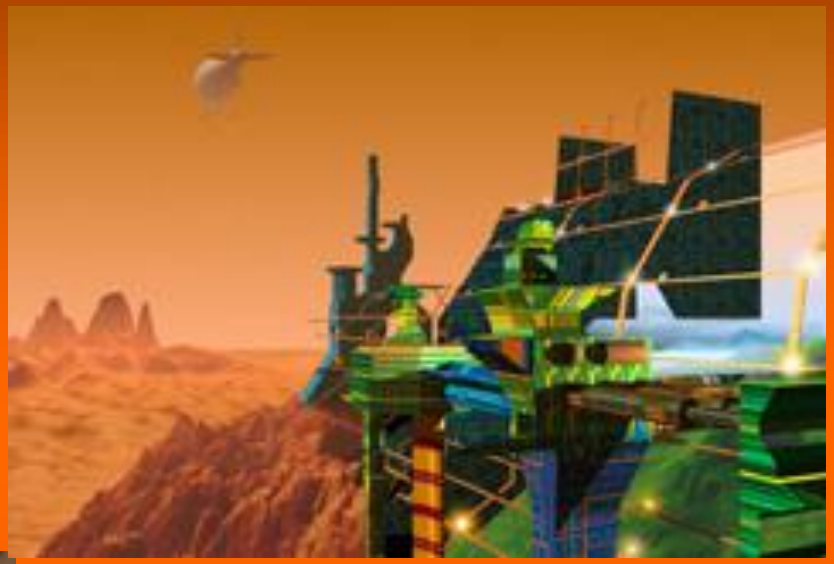

Low-Pressure Dome Enclosure
2.56 cm
2.56 cm
12.70 cm
12.70 cm
20.49 cm
12.79 cm
3.83 cm
55.71 cm
55.71 cm
2.54 cm
55.74 cm
54 cm
2.54 cm
74.07 cm

Biosphere -2



Preparation of the planet for: Terraformation

One of the main topics for a scientific and research project of the Martian base



Scientific and research aims: Search for life on Mars

Source of information – a textbook in SCIENCE FOR GOODS for nourishing goods

HRISTO DONCHEV
ANDREJ ANDREEV

University publisher
Economic university - Varna

Field-CHEMISTRY

Several ways for creation of water and oxygen in the Martian base!

№1

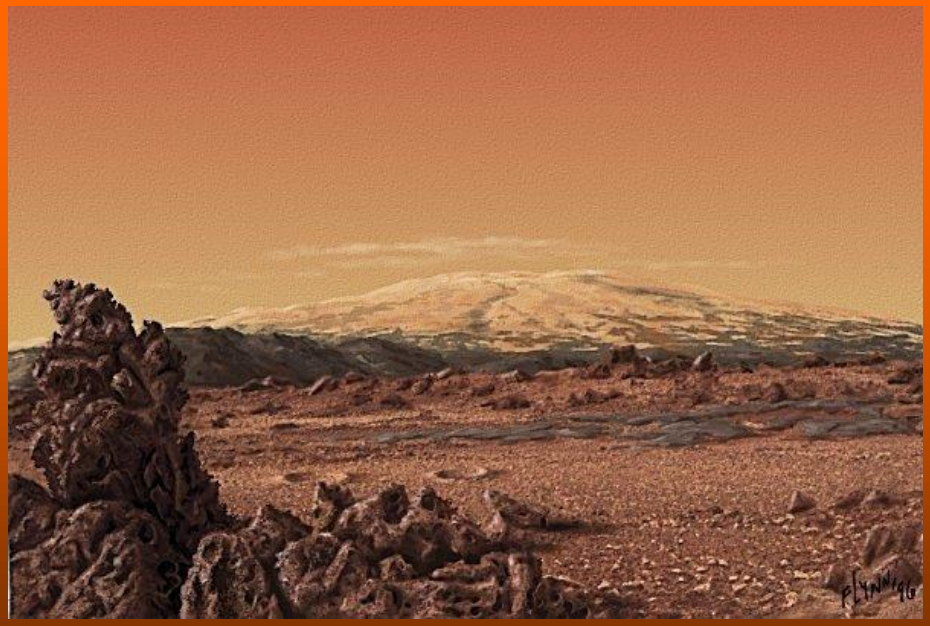
$$Na_2O + 2HCL \longrightarrow 2NaCL + H_2O$$

This chemical reaction shows how we can receive salt and water after the interaction of disodium oxide and hydrochloric acid.

№2

$$2SO_3 \longrightarrow O_2+2SO_2$$

Here, after the decomposition of two molecules sulphur trioxide, we receive oxygen

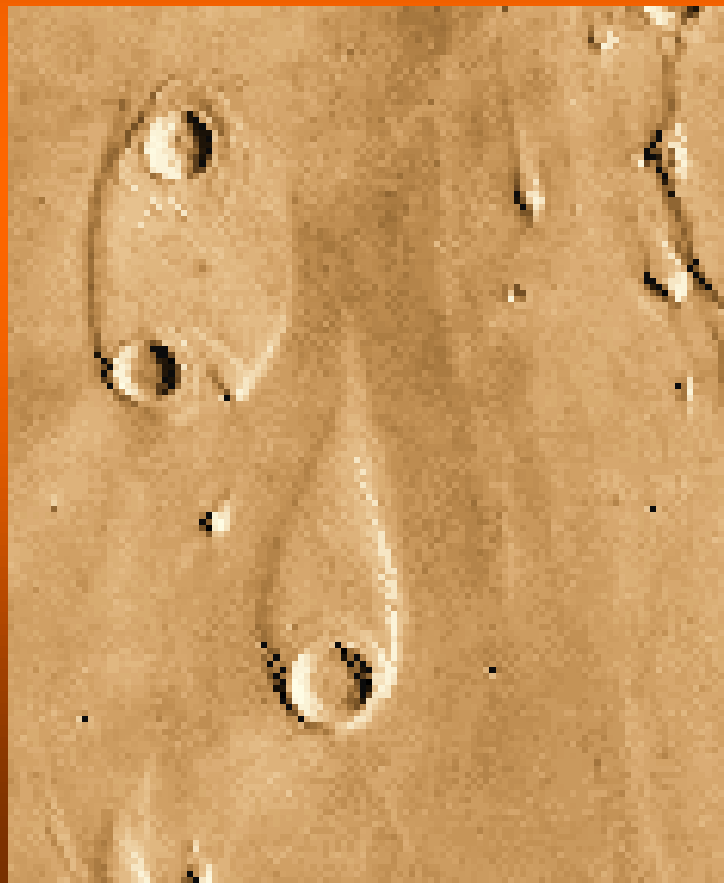


№3

$$CH_4 + 2O_2 \longrightarrow CO_2 + H_2O$$

Here, during the process of burning, we can receive water and carbon dioxide that is useful for the growth of plants.

This is possible if enough quantity of oxygen is present.



№4

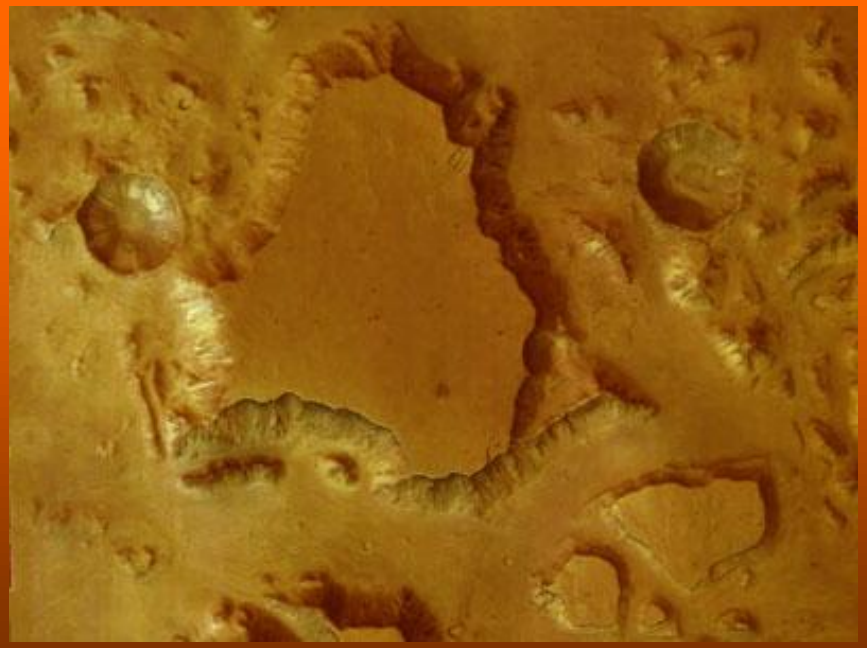
$$2H_2O \longrightarrow O_2+2H_2O$$

This reaction of decomposition is the most appropriate compared to the previous reactions because we receive two substances that are very important for us – oxygen and water

№5 p t

$NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

Here, if burning occurs in an oxygen-containing medium, we receive large quantities of water, but this reaction is very expensive because of the large quantities of oxygen and platinum as catalysts.



№6 Electricity

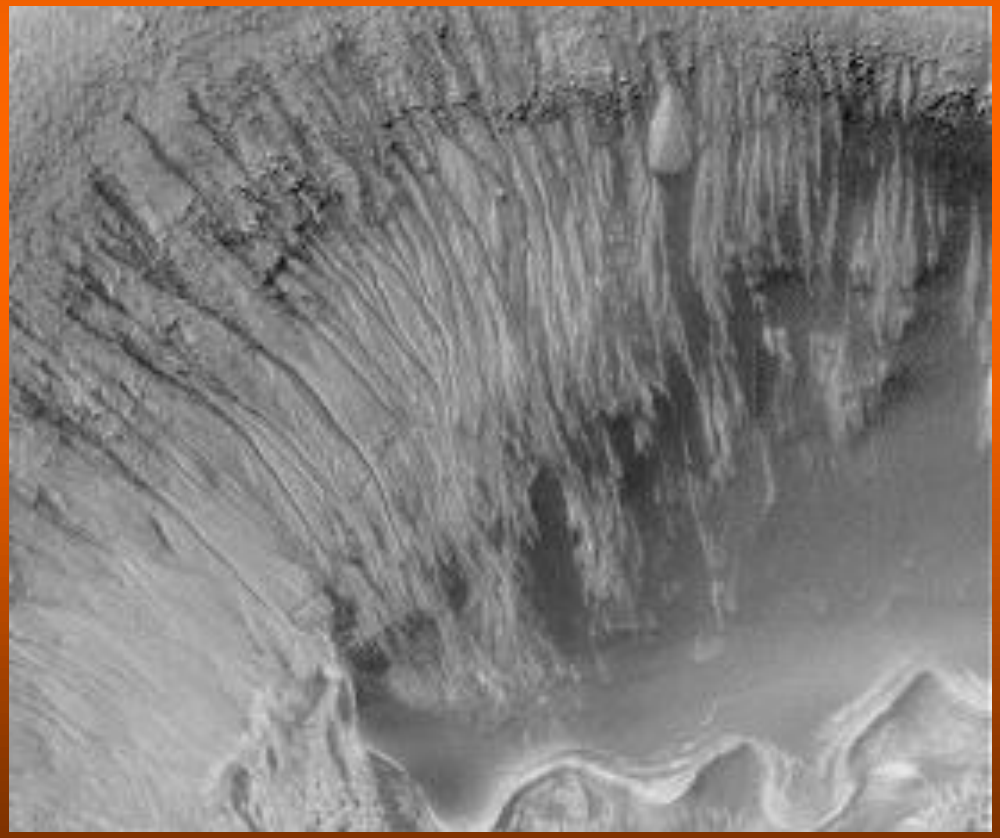
$$2H_2O \longrightarrow 2H_2+O_2$$

In this process of decomposition of water under the influence of electricity, we receive oxygen and much water that can blow up if temperatures are very high.

№7

$CO_2 + H_2 \longrightarrow CO + H_2O$

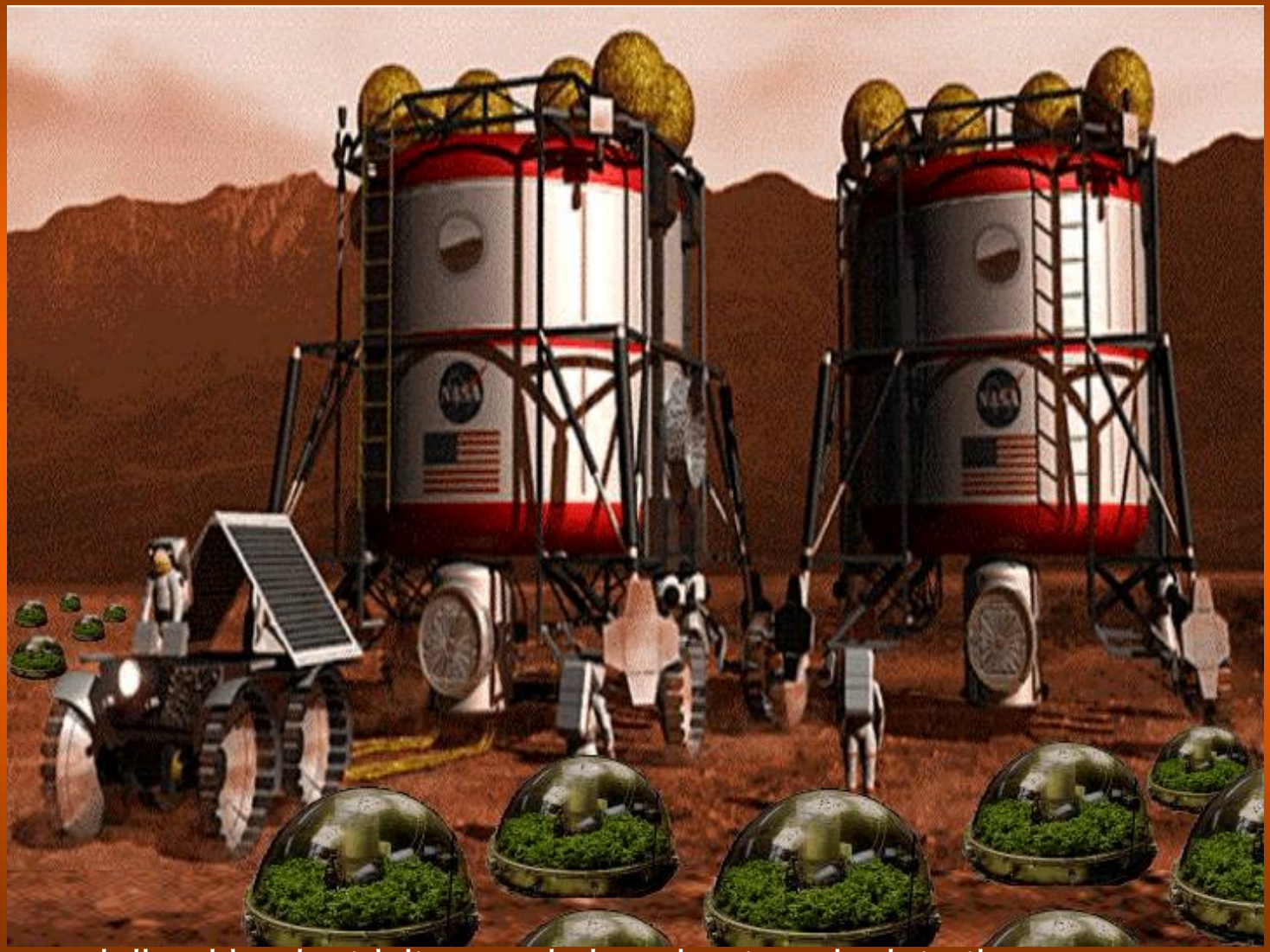
This is the last chemical equation that shows how we can receive water.



Special thanks to our teacher in chemistry, with whom we made all versions for receiving air and water in the base

The amount of water and oxygen in these chemical reactions depends on the substances at the beginning, which means that the more oxygen there is, the more water we are going to receive!

Energy sources: nuclear reactors and solar batteries



The team specialized in electricity supply is going to calculate the necessary amount of electricity vital for the functions of the main base

ОБРАЗОВАТЕЛЕН ПРОЕКТ "МАРСИАНСКА БАЗА"

EDUCATIONAL PROJECT "MARS GATEWAY"

За проекта Цели на проекта Хроника на проекта

За проекта:

От векове човечеството мечтае да разкрие загадките за своя произход, тайните на раждането на Вселената и да реши проблема с възникването на живота.
Ако открием други населени планети, разумни същества и успеем да осъществим връзка с тях, бихме могли в голяма степен да дадем отговор на много въпроси, които вълнуват човечеството.

Възобновяването на полетите до Марс, кацането на двете американски станции Спирит и Опюртюнити, полета на Европейската станция Марс експрес, както и решението на най-голямата космическа агенция НАСА за пращане на хора на планетата, провокира екип от ученици от Професионална гимназия по строителство, архитектура и геодезия "Васил Левски"-гр.Варна, да разработят

THE WORK OVER THE PROJECT IS CONTINUING!

You can see the discussion about the new problems and the possible solutions in the web page of the project!

We expect your comments and suggestions on the following address:

veselka.radeva@gmail.com

Thank you for your attention ☺