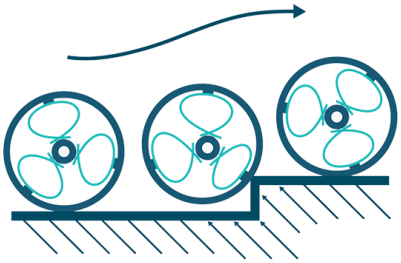
EQUIPPING A HABITAT ON MARS: a challenge of 3D printing

Rover's wheel:

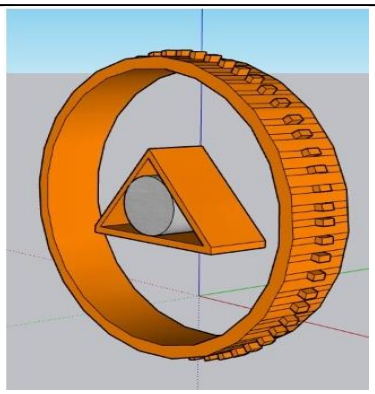
In order to replace the damaged wheel, we use a spring system (based on the "loopWheel"design) with a flexible bar to shape the spring. This flexible bar is made of kevlar because it is a material of low electrical conduction, high rigidity, tensile strenght, elongation at break, high chemical resistance, low thermal contraction and great shear resistance.

The track system was made this way so that the wheel can drive but the rest of the design was taken from the Rover Curiosity's pattern.

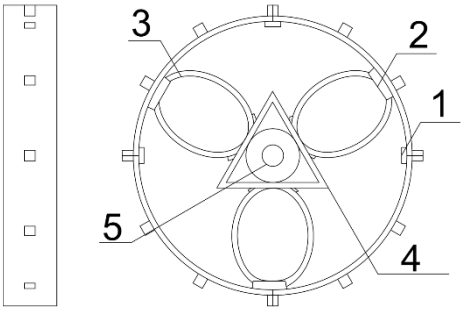
"LoopWheels" spring system



Rover's wheel replacement

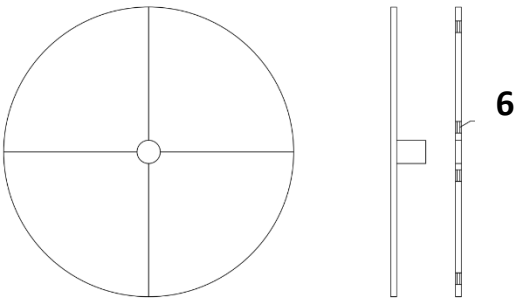


Rover wheel prototype



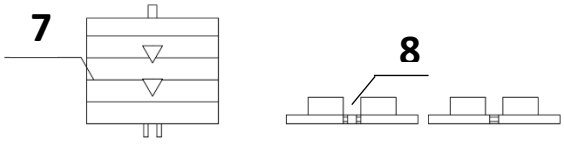
1- Joint plate
2- Tie plate Wheel loop
3- Kevlar loop
4- Mass support and loops
5- Rim shaft

Wheel protection cap



6- latching system

Caterpillar wheel



7- Traction line
8- Link system

Obtaining kevlar:

We chose Mars to produce kevlar because its great qualities and also to be able to manufacture the Rover's wheel of exploration.

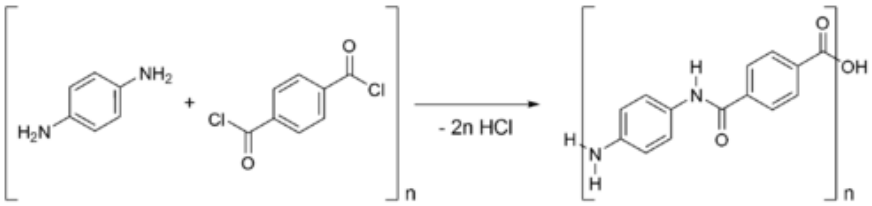
Another reason why we chose Mars is because we can find easily the compounds that are used to produce kevlar on Mars itself.

And last but not least, this subtance has both physical and mechanical properties which are perfect at the moment of investigating because it does not damage the material.

obtaining synthesis:

The synthesis of this polymer is carried out in solution of N-methy pyrrodilone and calcium chlride through a stepwise polymerization from p-phenyldiamine and terephthalic acid chloride

the reaction is carried out at low temperatures due to its high exothermicity. The polymer is then precipitated and dissolved in concentrated sulfuric acid where Kevlar forms a crystalline solution that is used to precipitate or coagulate the fibers as they are drawn by a spinning system.



obtaining hydrocarbons

Mars gives us HCL (hydrogen chloride)

With sodium chloride we are interested in obtaining the Cl ion. To then obtain gaseous Chlorine.

The reactions would look like this:

$HCl + H_20 \rightarrow H_3O^+ + Cl^-$

$NaCl + H_2O \rightarrow 0{,}5\ Cl_2 + NaOH + 0{,}5\ H_2$

Then, with the Methane obtained in the atmosphere of the planet, we halogenate it so that later, with reactions by additions, we will generate more hydrocarbons with a longer chain.

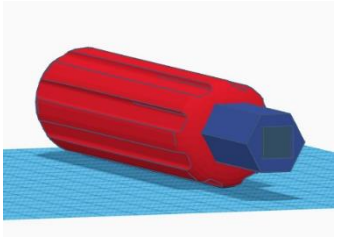
$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

The chlorine molecule is replaced by methyl and ethane that was formed.

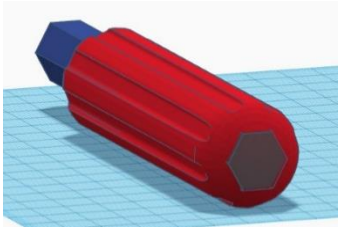
These same ones can be repeated to synthesize hydrocarbons to later obtain some monomer produce some polymer necessary to manufacture materials.

Universal hand tool:

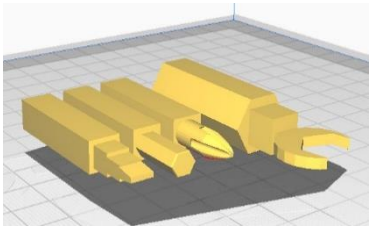
Multipurpose tool, it consists of a central solid metal bar covered with a plastic handle for a better grip and comfort in its use, said bar is hollow at both ends, the ends have a single slot in which the different pieces to be used are embedded. The pieces used can be screwdrivers, different types of wrenches (wrench, stillson, monkey, etc.) In addition, kitchen utensils such as a knife, fork and spoon can be incorporated. The interchangeable tips have a socket of approximately 3.5 cm.



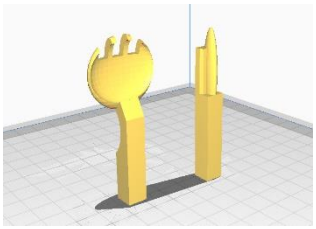
Front



Behind



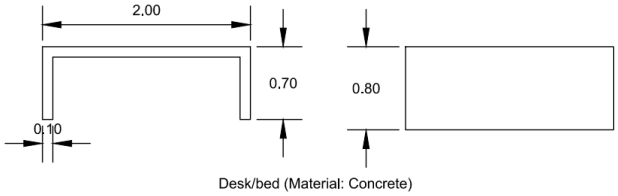
Tool heads



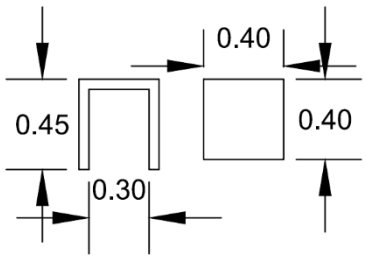
Utensils

Forniture:

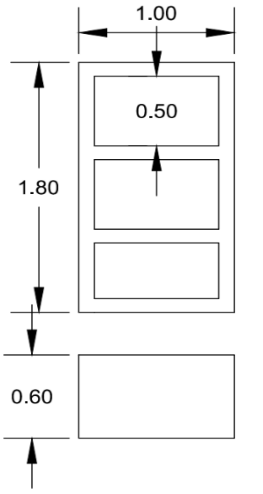
built of concrete, three different models were designed: chair, table and shelf. The measurements are detailed in the images below.



Desk/bed (Material: Concrete)



Chair (Material: Concrete)



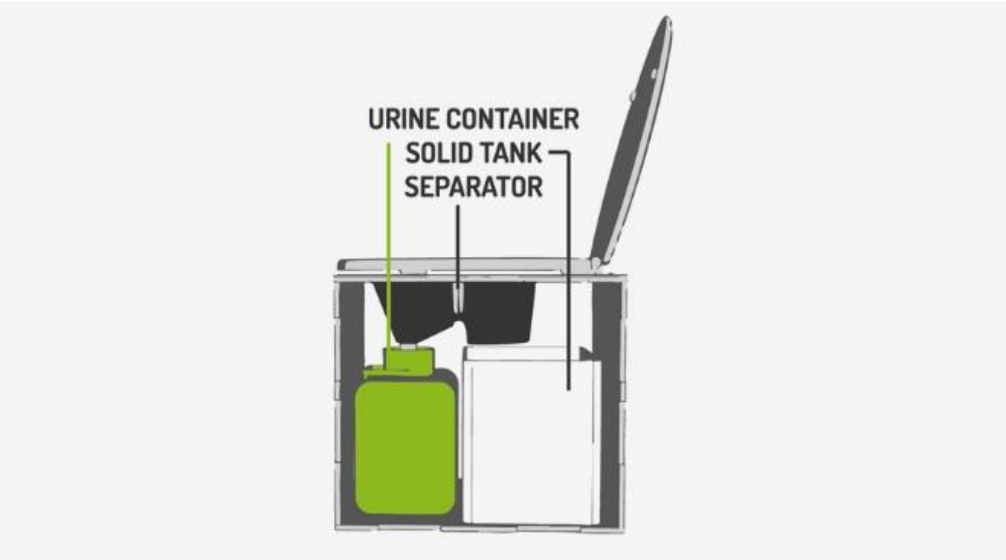
Shelf (Material: Concrete)

Dry Latrine with urine divertion:

The latrine is divided into two parts. The urine drains through the frontal tube whereas the droppings flushes through the back tube, which is bigger. All of this waste can be used as organic fertilizers, for example through a process of inverse osmosis, urine can turn into fluid suitable for human consumption.

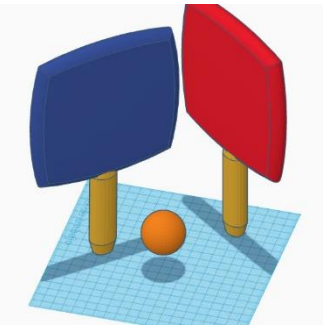
Concrete will be used as building material since it must bear a person's weight, and we will use plastic to build the lids. The following illustrative picture belongs to a desing from "kildwick", a company engaged in composting toilet construction.
The location of the bathroom is designed so as not to cause cross contamination, as well as a possible future exercise area that should be adjacent to it. By locating these areas away from others such as the kitchen and recreation room, negative effects on the health of the inhabitants are avoided.

proportions: height: 45cm, width: 39cm, lenght: 58cm

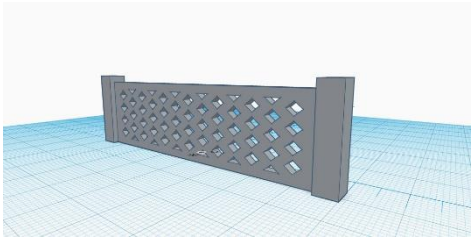


Recreatioins:

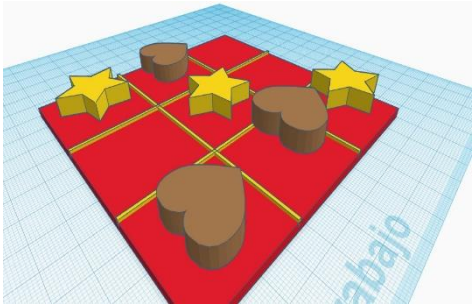
In order to avoid boredom and keep the body moving, the apple from mars team designed some recreational games, the objective of these games is detailed above, manage to disperse and pass the time in an active way at the times they want.



Ping-Pong



Ping-Pong net



Tic-tac-tou