

Name: _____ Group: _____

MATERIALS AND THEIR PROPERTIES

ESA (EUROPEAN SPACE AGENCY)

The study of materials and their properties is a key process in Spacecraft design. Main components and structures must support space extreme conditions, such as strong acceleration and braking, solar wind actions, electromagnetic radiations and the impact of particles and space junk.

A spacecraft structure must be light since it is expensive send it to the space and resistant in order to endure the strong impacts from space junk and particles. Another important property that spacecraft materials must have is electrical conductivity, since a spark or power surge could cause electronic equipment damages. On the other hand, magnetic materials could affect the navigation instruments sensibility, so we must avoid the use of magnetic materials and finally, a good isolation from electromagnetic radiations is recommended.

The European Space Agency (ESA) has designed and built service modules for the Spacecraft Orion. These modules are in charge of ensure astronauts survival as well as the propulsion. For it the modules contain great fuel tanks and supplies for astronauts (oxygen, nitrogen and water).

With the following experiments we are going to find out which materials are suitable for spacecraft design.



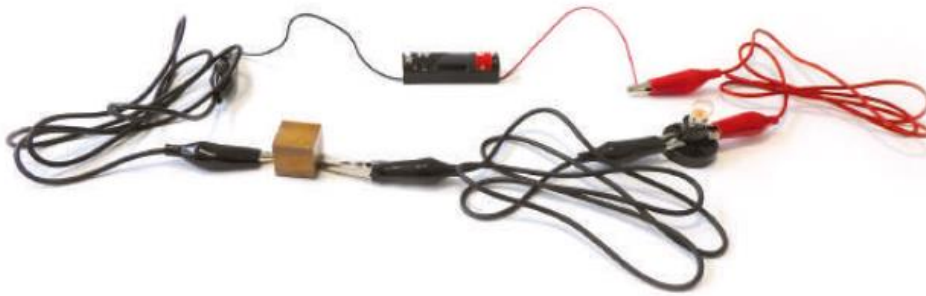
Orion with ESA module

ELECTRICAL CONDUCTIVITY

We need conductive materials, so in order to find out which materials has this property, we can insert the materials samples in an electrical circuit.

We need materials samples 2x2x2 cm, a battery with his battery holder, some cables and a lamp and his socket.

If the electrical current break through the chosen material, the lamp will light. The best conductive materials produce a more intensive light.



Circuit with a material sample

MATERIAL		N°	CONDUCTOR OR INSULATOR
	Copper	1	
	Aluminum	2	
	Brass	3	
	Steel	4	
	Wood	5	
	Stone	6	
	Plastic	7	
	Polystyrene	8	
	Aluminum alloy 6061	9	

DENSITY

We need low density materials, so we can calculate it by finding the mass and the volume.

The volume can be calculated in an easy way, in fact, we know the measure of the cubes. Each sample material is cube shaped and their dimensions are $2 \times 2 \times 2 \text{ cm}^3$.

With an electronic scale we can find out the mass and apply the equation:

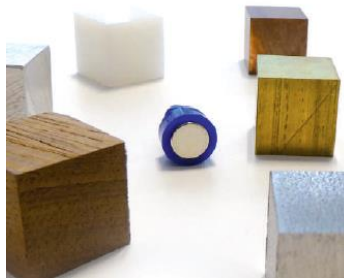
$$D = m/V$$








MATERIAL	Mass (g)	Density (g/cm ³)
 Copper		
 Aluminum		
 Brass		
 Steel		
 Wood		
 Stone		
 Plastic		
 Polystyrene		
 Aluminum alloy 6061		

MAGNETISM

For our Spacecraft we need non-magnetic materials, so the best way to classify magnetic and non-magnetic materials is by using a magnet.



MATERIAL	Magnetic or non - magnetic
 Copper	
 Aluminum	
 Brass	
 Steel	
 Wood	
 Stone	
 Plastic	
 Polystyrene	
 Aluminum alloy 6061	

CONCLUSIONS

Choose the best material for the Spacecraft investigation and give some reasons for you choice.
