ENGINEERING MATERIALS INTRO SS

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Materials for educational purposes

https://www.metaltek.com/blog/how-to-evaluate-materials-properties-to-consider/

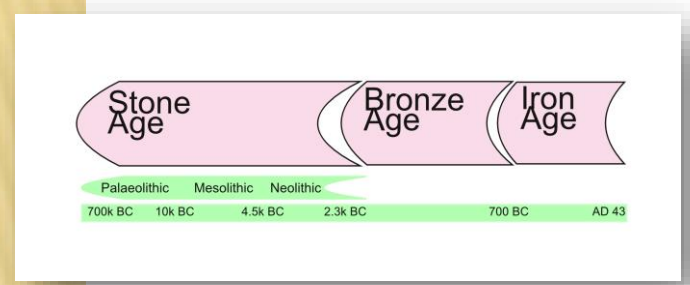
https://technobyte.org/engineering-materials-classification-properties-applications/


MAGNETISM
SINTERING
MATERIALS SCIENCE
POLYPROPYLENE
MINERALOGY
METALLURGY
SOLID FICTION
TOOL
CARBON
DIFFUSION
POLYMER
PLASTIC
SUPERALLOY
WELDING
MICROPROBE
STEEL
ALLOY
SYSTEM
GLASS
BIOMATERIAL
TECHNOLOGY
MICROSCOPE
QUENCHING
PHOTONICS
SILICON
MODELING
COATING
NAUTILUS
MODELING
PHYSICS
DIAMOND
LITRACON
STEREOCHEMISTRY
AEROGEL
SEMICONDUCTOR
SILICENE
HEAT
FIBER
CRYSTAL
TRIBOLOGY
NEUTRONTITANIUM
FULLERENE
DARPA
ENERGY
CERAMIC
TALC
CHEMISTRY
KEVLAR
NANOTUBES
NANOMATERIALS
ENGINEERING
MICROSTRUCTURE
AMORPHOUS
ZBLAN

INTRODUCTION

- Materials are an important aspect of engineering design and analysis.

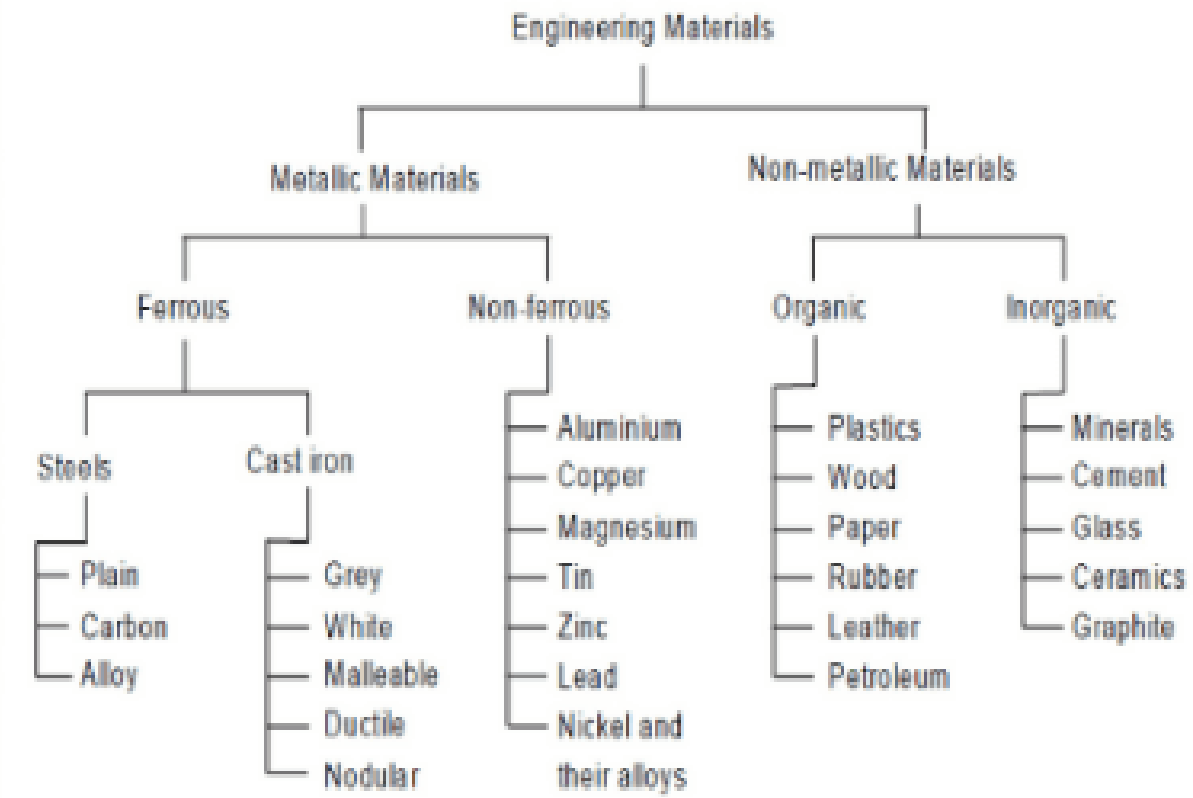
- The importance of materials science and engineering can be noted from the fact that historical ages have been named after materials

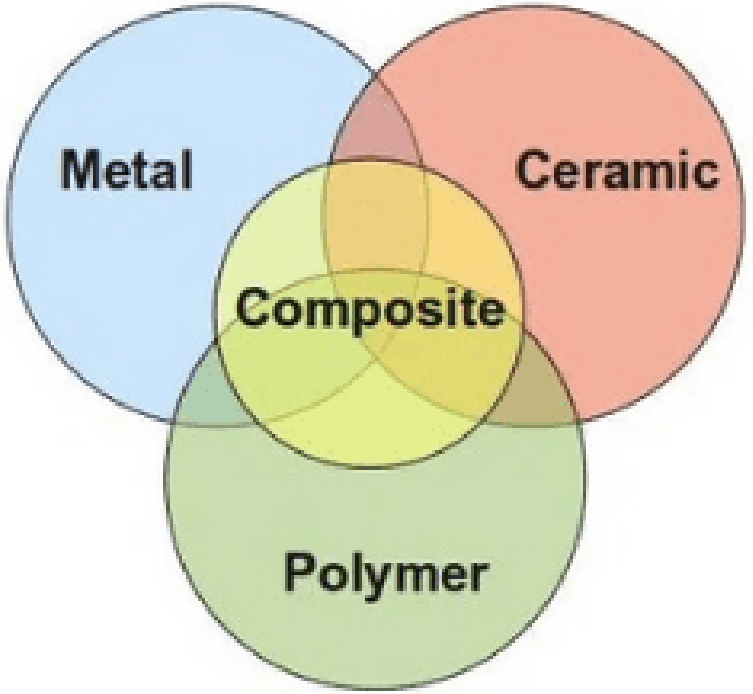


- There is a wide variety of materials available which have shown their potential in various engineering fields ranging from aerospace to house hold applications.

- The materials are usually selected after considering their characteristics, specific application areas, advantages and limitations.

What are the Classifications of Engineering Materials?





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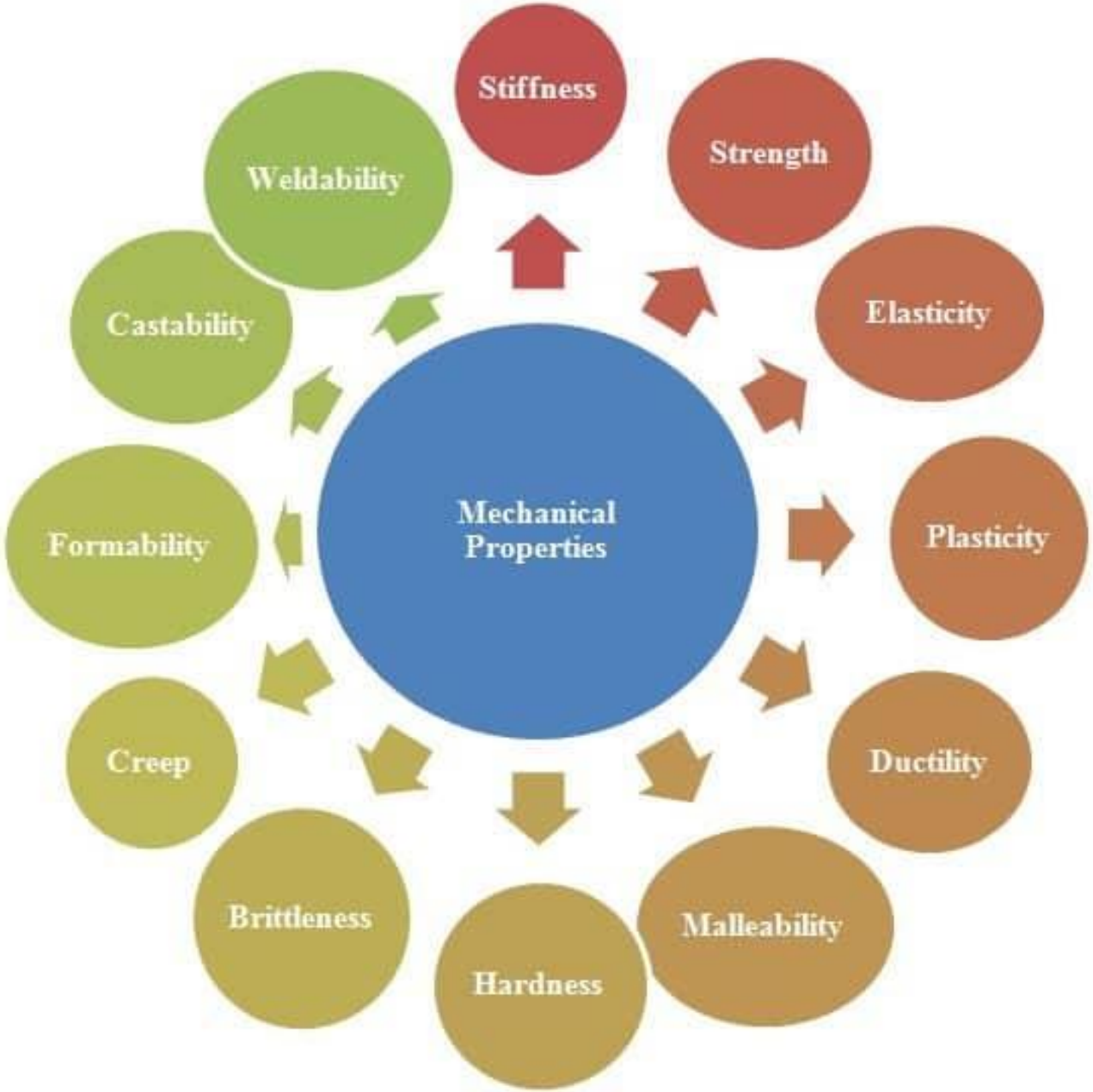
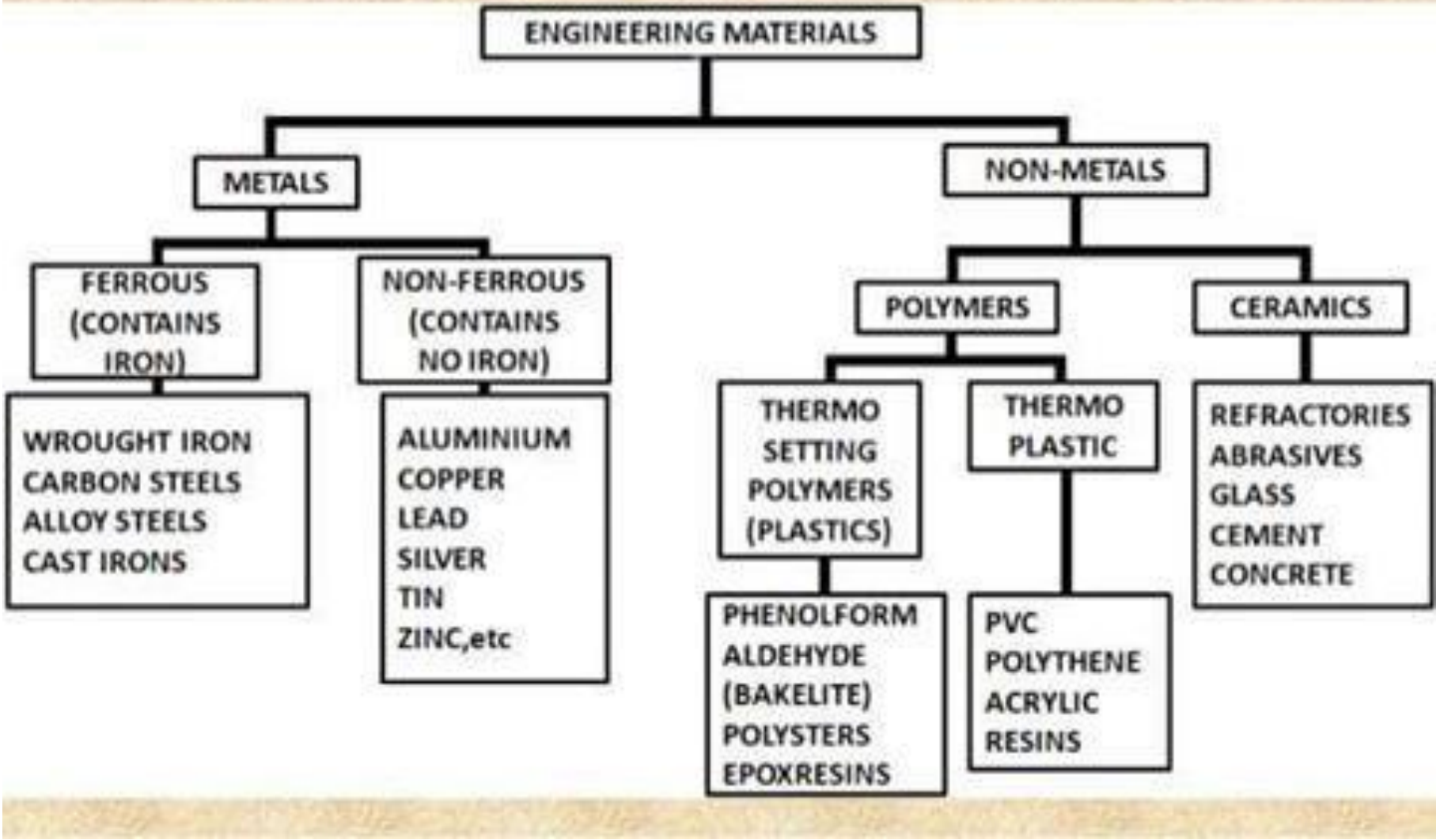
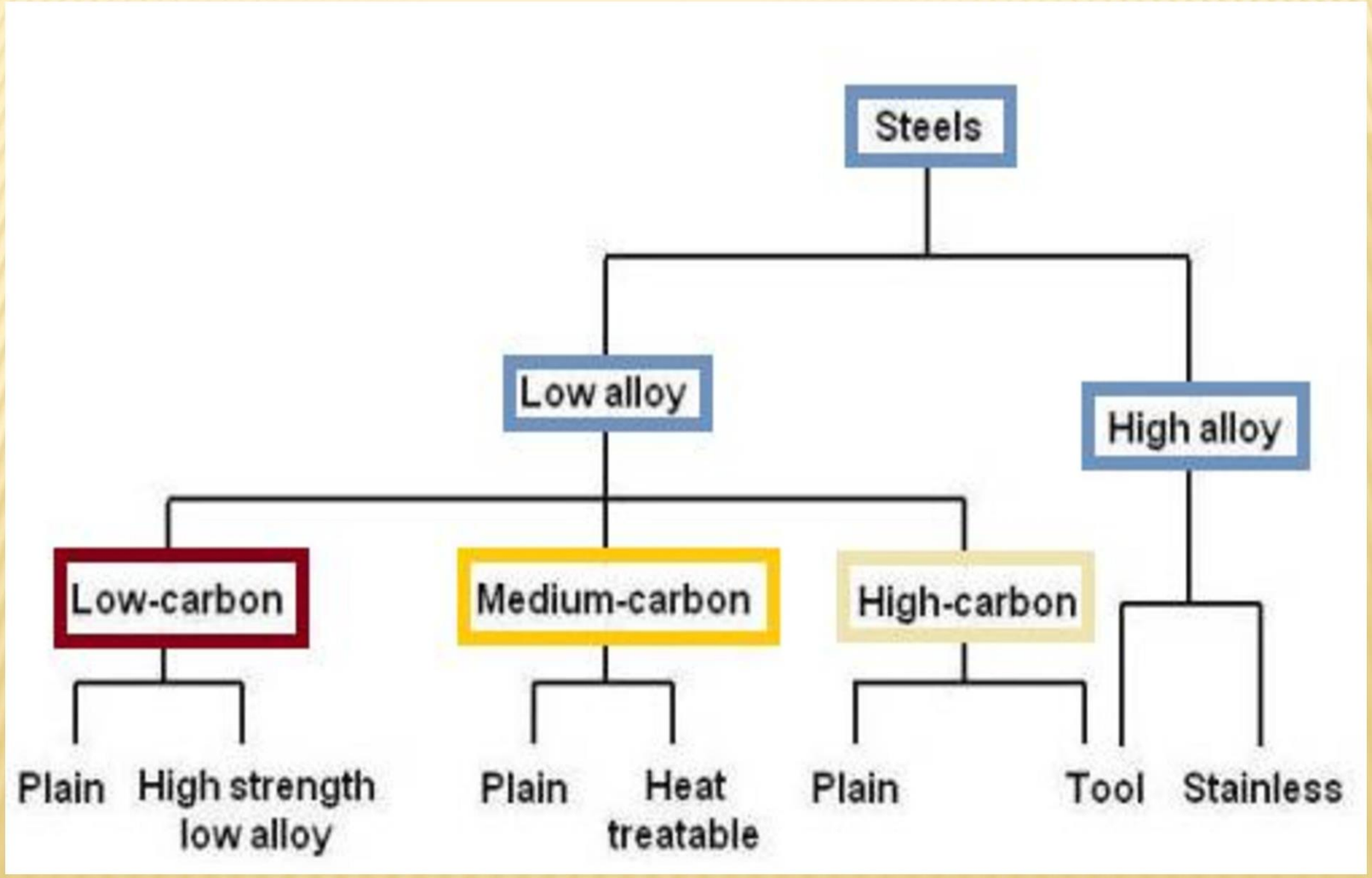
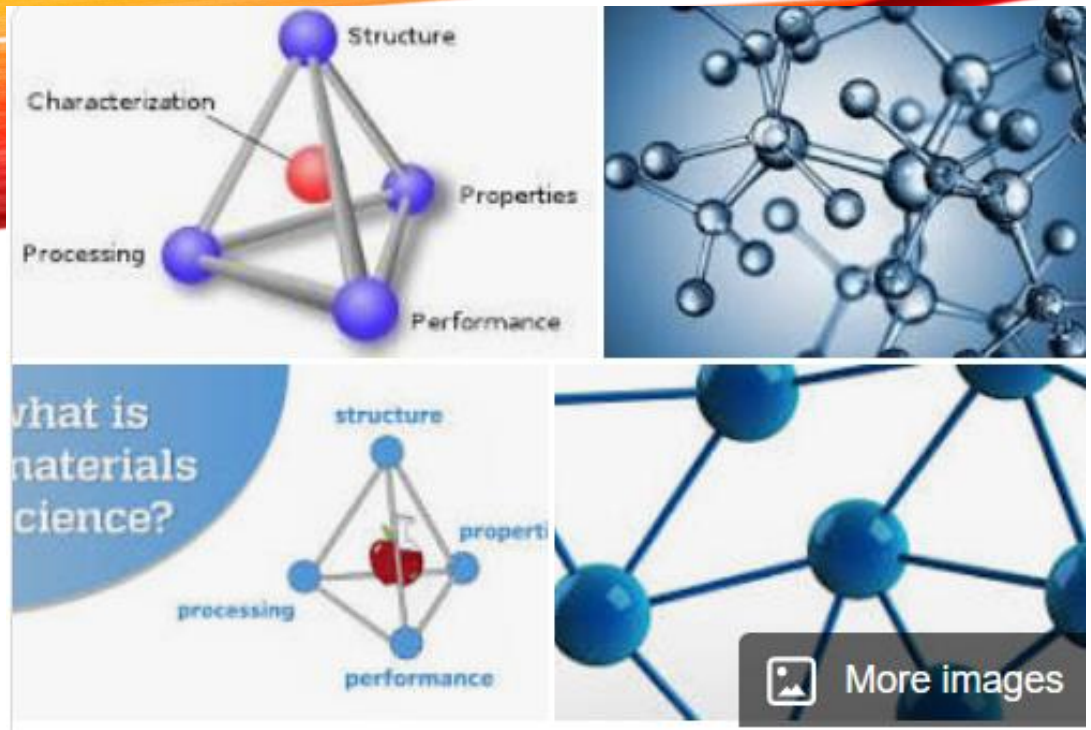

Mechanical Properties
Stiffness
Strength
Elasticity
Plasticity
Ductility
Malleability
Hardness
Brittleness
Creep
Formability
Castability
Weldability

CLASSIFICATION OF ENGINEERING MATERIALS



Classification of Steels





Materials Science

Field of study

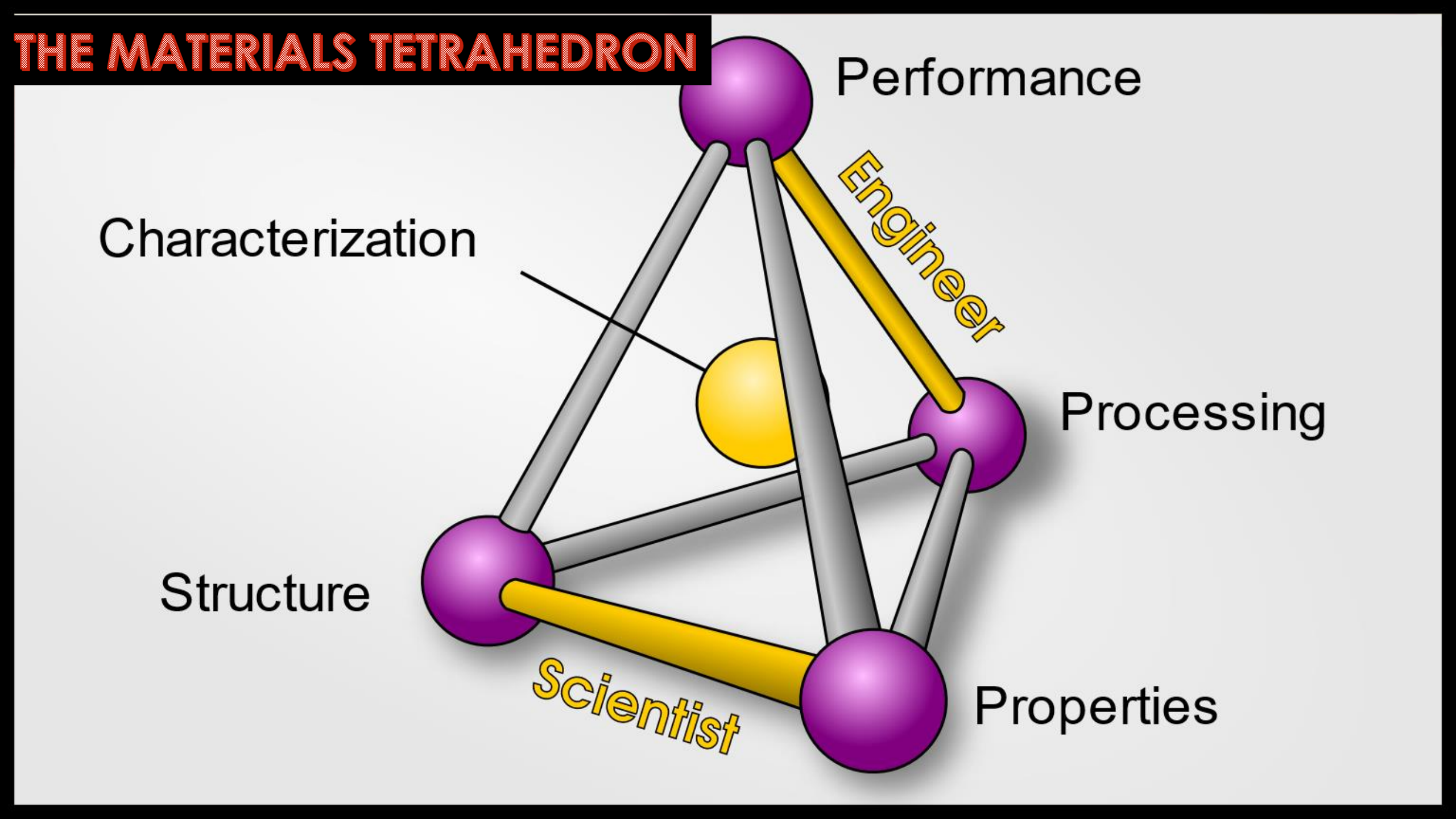
Materials science is an interdisciplinary field of researching and discovering materials. Materials engineering is an engineering field of designing and improving materials, and finding uses for materials in other fields and industries. Wikipedia

MATERIALS ENGINEERING

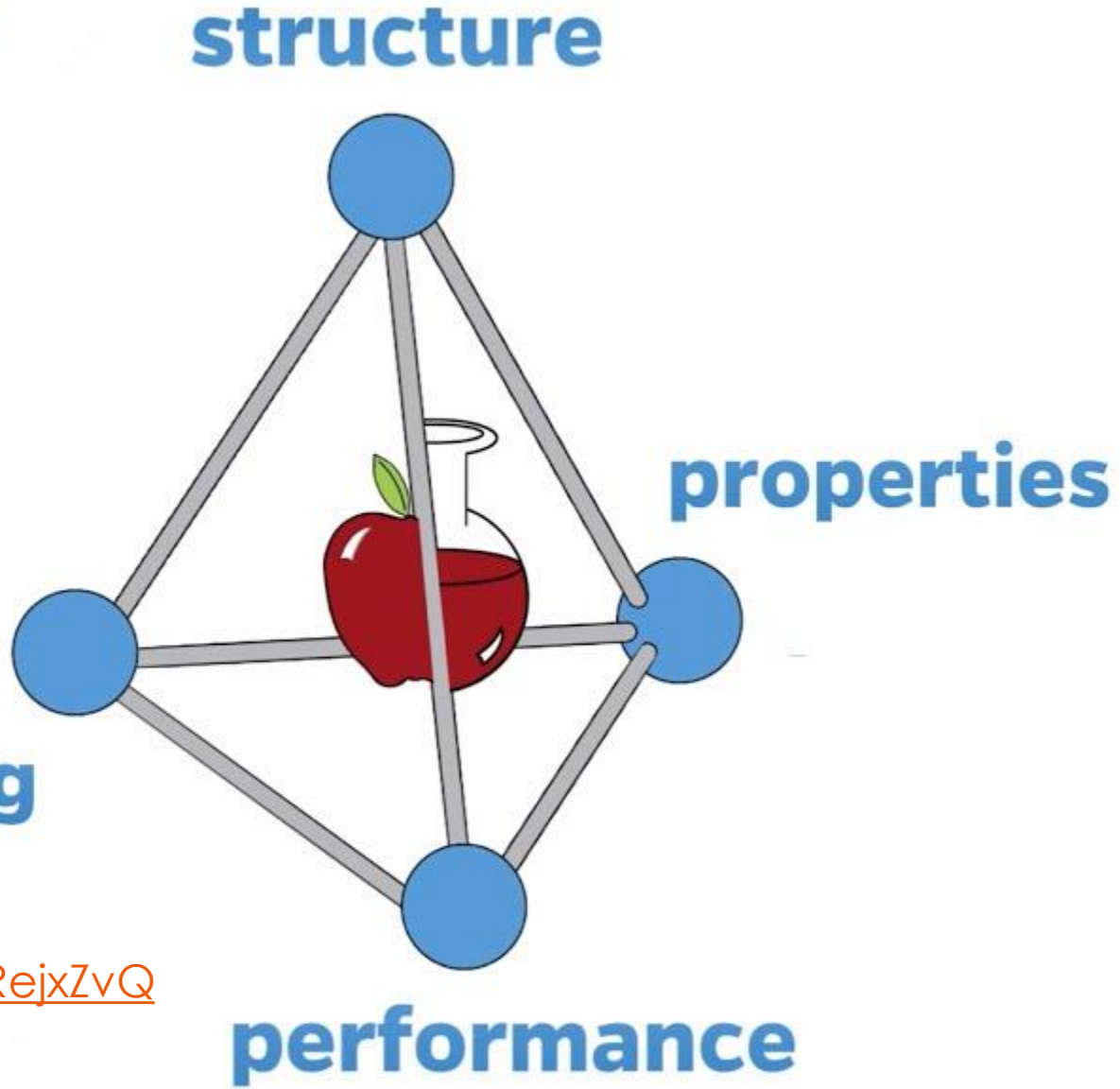
DESIGNING, PROCESSING, TESTING, AND DISCOVERING MATERIALS (MAINLY SOLIDS)

https://youtu.be/x5OD2KZXd54?si=FMxdjgeewG250n1V

THE MATERIALS TETRAHEDRON



what is materials science?



https://www.youtube.com/watch?v=wVCMRejxZvQ

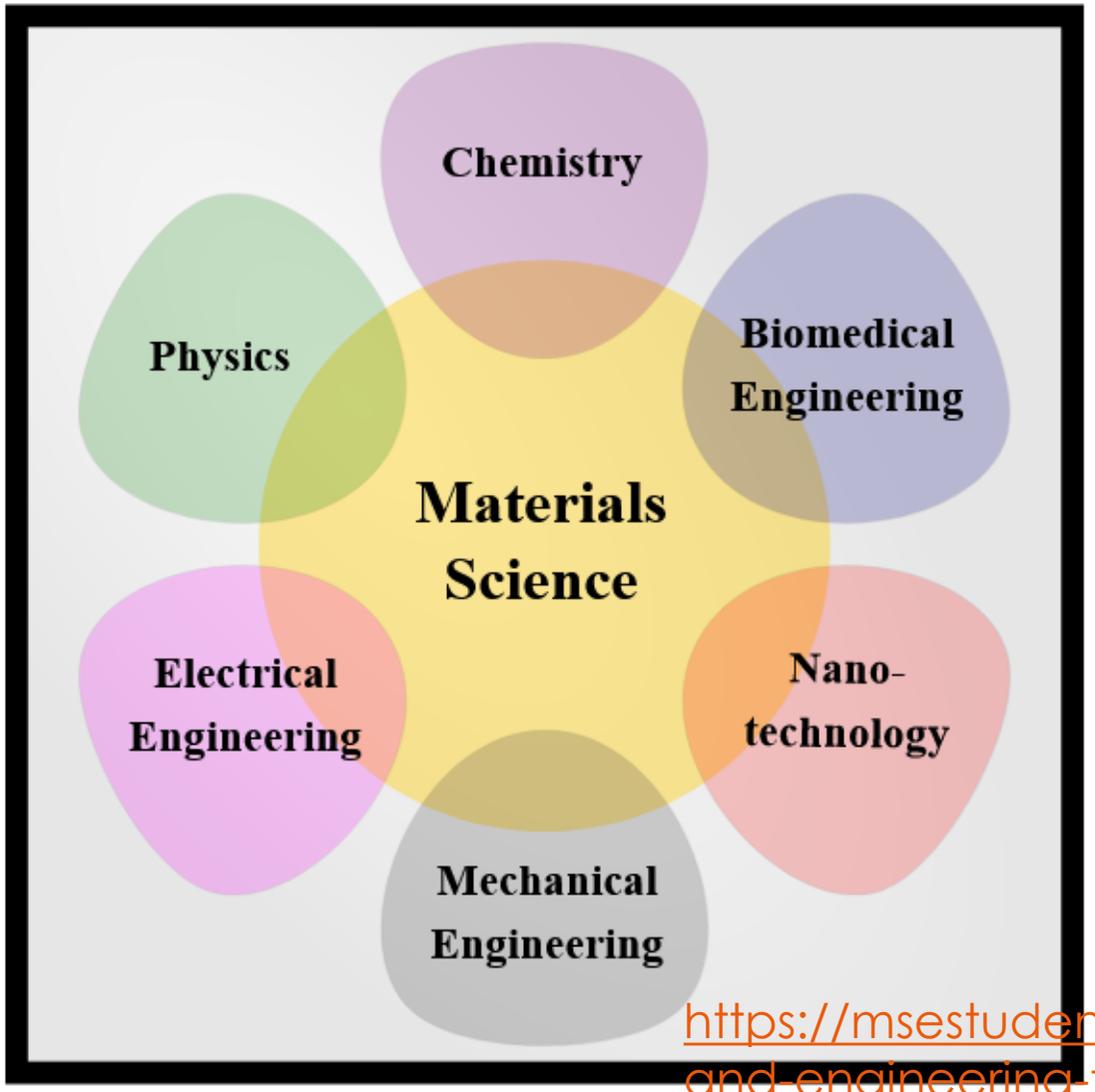
- **Performance** is how good a material is. Can it be used as landing gear? How about as an insulator? A material's performance is tied to a combination of separate properties.
- **Properties** are macroscopic things about a material that you can measure–hardness, elasticity, thermal conductivity, electrical conductivity, density, coefficient of friction, etc. Properties are determined by a material's structure.
- **Structure** is the feature of a material operating on different length scales. Structures can be large enough to see with the naked eye, or as small as atomic spacing. Some examples of structures include pores, precipitates, grain boundaries, grain orientation, and crystal structure. Structure is often influenced by processing.
- **Processing** refers to the steps needed to create a material. This often means the final steps to create a material–for example, heat treating and quenching to influence grain size–but it can even include mining raw ore and converting it into a more useful state.

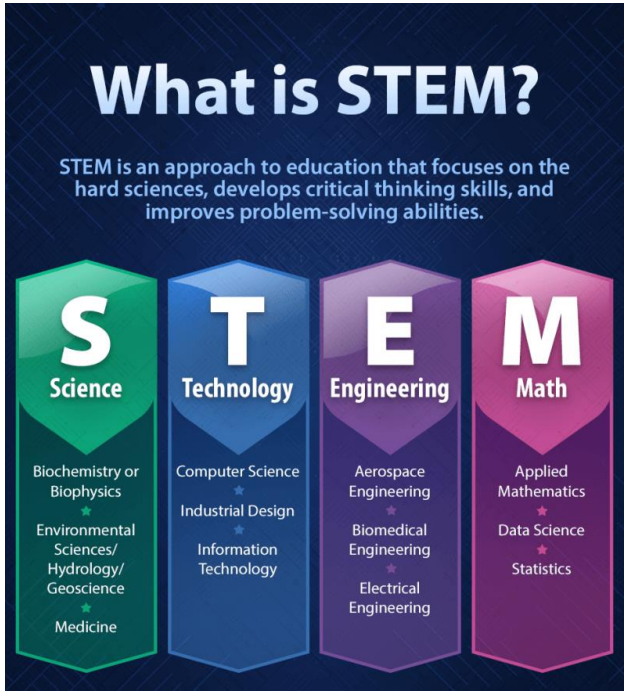
All 4 of these points interact, which is why the tool is typically visualized as a tetrahedron, with edges connecting each side.

Materials science is a unique combination of science and engineering, physics and chemistry, logic and creativity.

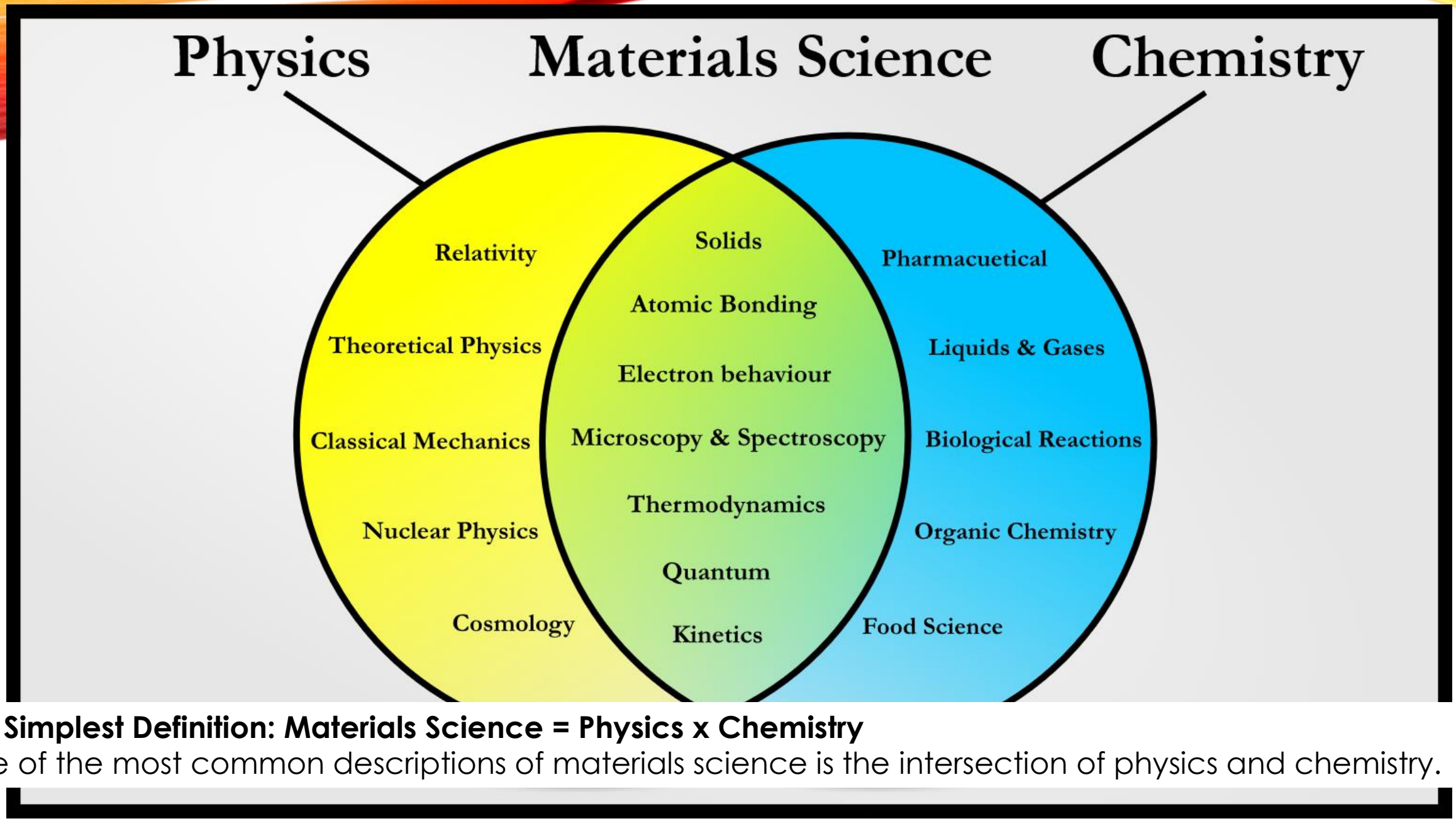
It's also important to discuss what materials science is within the context of modern STEM fields.

Materials science, while critical for modern technological advancement, is not well known.





https://msestudent.com/what-is-materials-science-and-engineering-the-definitive-explanation/

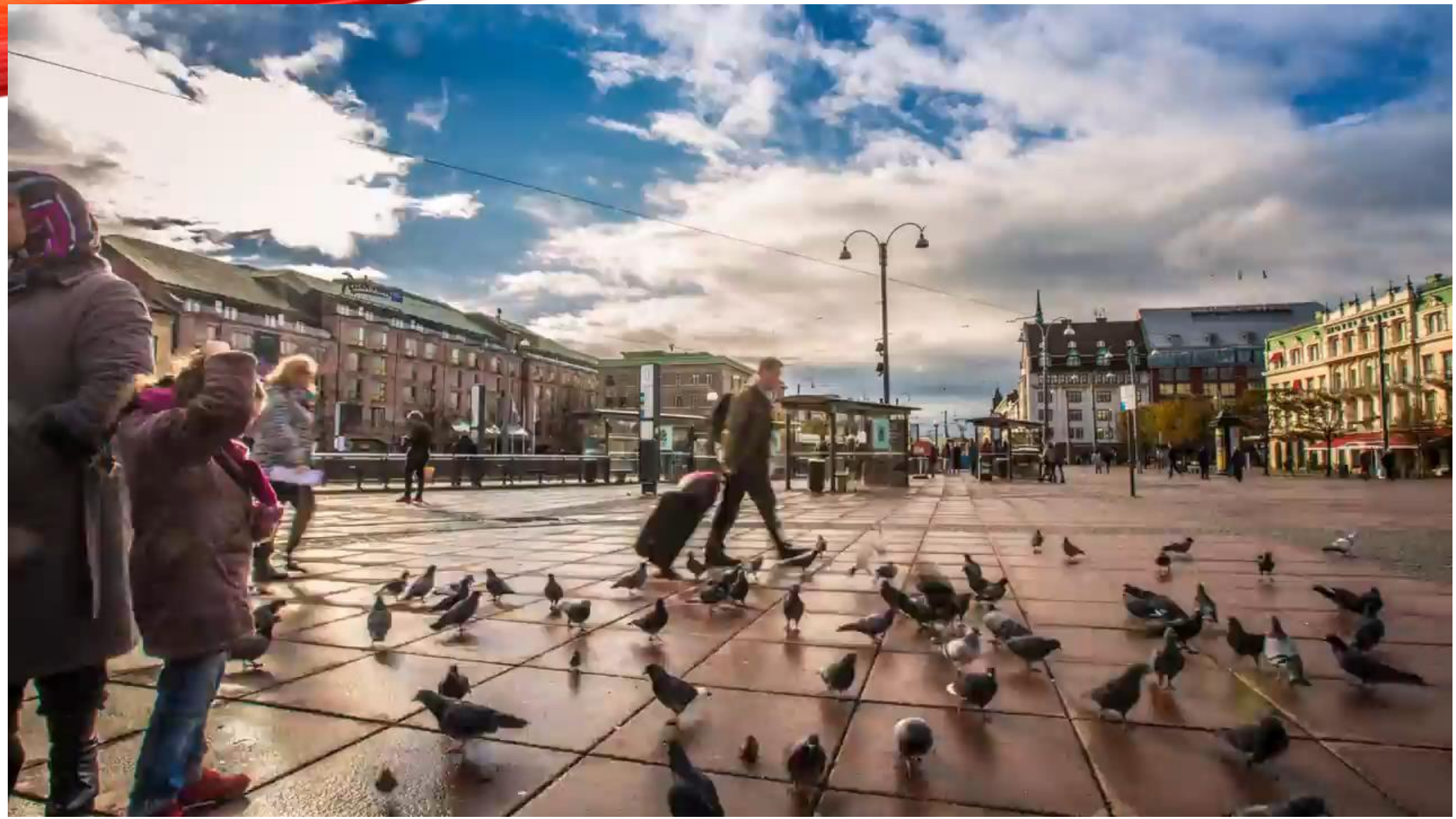


The Simplest Definition: Materials Science = Physics x Chemistry

One of the most common descriptions of materials science is the intersection of physics and chemistry.

https://youtu.be/_cUEjPtVIIM

MATERIALS SCIENCE



What is materials science? Video transcript

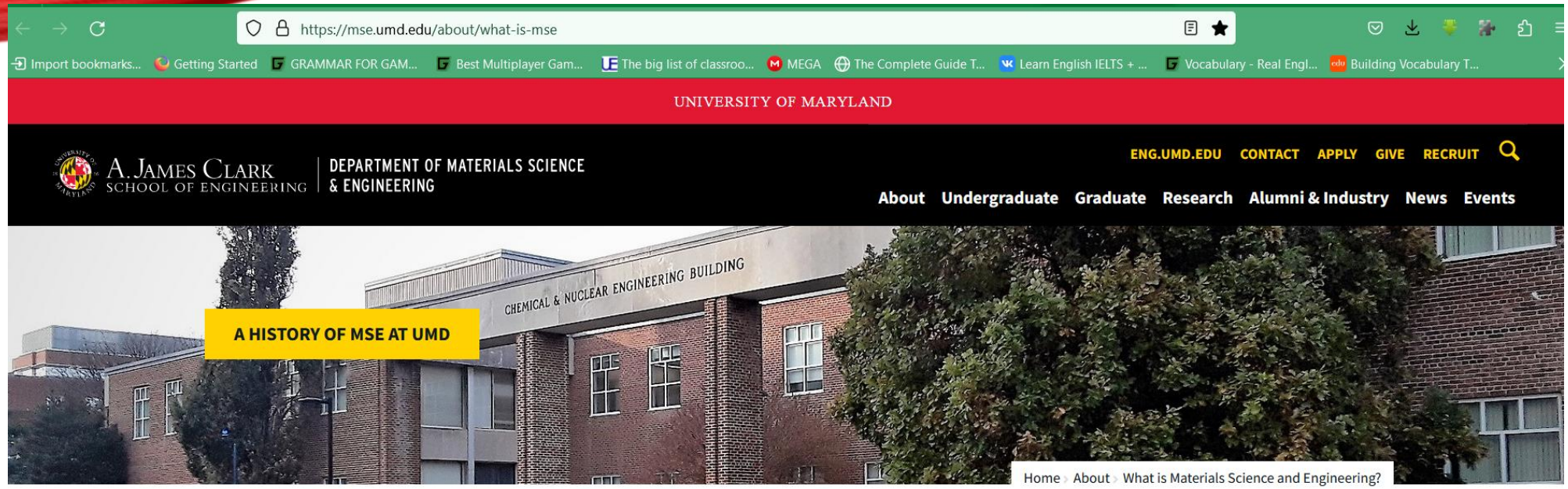
Do you ever think about the research that goes into the stuff that we use every day? Pretty much everything we own contains a complex mix of materials that we have discovered, designed and then developed. And all this is the result of material science.

Materials scientists studied the properties of materials and how these properties are determined by the structure of the material and the different components making up the material. Okay, so even if early humans didn't realize that at a time, we could say that material science started when we learned how to extract metals from rocks and then shaped them into tools and weapons and other things that we needed. The Bronze Age around 3500 BC was a major material technology shift, discovering that copper and tin could be combined for the much more superior metal bronze. Following the Bronze Age came the Iron Age, which was probably more important to our lives today. During the Iron Age, the best weapons and tools were made from steel, which is an alloy between iron and carbon. But there was a fine line to get the carbon concentration just right. Not enough, and the steel couldn't be heat treated as much and wouldn't be as strong. Too much carbon and the steel became hard but brittle.

So as you see, there was some science to get right already. Then we just didn't call it material science, and the tools to make them have changed a bit too.

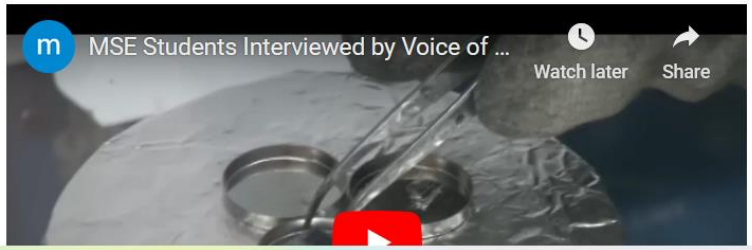
One of the major steps for material science was the invention of plastics. The first completely synthetic plastic was called Bakelite. It was presented to the American Chemical Society in 1909 by its inventor, Doctor Leo Baekeland. It's not hard to understand why moldable synthetic polymers so quickly became popular when we consider the alternatives we had before them. Ivory, for many reasons, a terrible choice of material used for things like pool balls and buttons and then the materials shellac, which was the substance secreted by the East Asian lac bug. It had to be scraped off of the trees inhabited by the animal before it could be used, for example, to coat electrical cables. Over the past 100 years, material science has moved forward at an incredible pace, sparked by things like space, technology, medical advancements, and of course, our love for technology. One problem that had to be solved before the Apollo space missions was how to get energy. The result was to use the sun and solar panels were invented. Also, new spacesuits didn't just mean the latest colors, but also improved materials. The new moon boot material later revolutionized running shoes when used as a shock absorbent. Advancements in medicines also called for new materials. By applying special coatings to medicines, we can now control where and when medicines are released in the body, and we also have new materials that can be drilled into the bone. And then we have all our electronic toys. Not too long ago, this was what we used for music, and now all we have to do is slide and touch. Today's materials scientists are fighting even bigger challenges, like how can we make sure future generations have the same chance to meet their needs as we do? Here we go. Oh come on, how can we keep growing without running out of resources, materials that won't pollute the environment, lightweight materials to cut energy requirements, and transportation materials that can easily be recycled and put less stress on natural resources. If you want more specific examples, check out the other videos that we have done on some of the major questions that material scientists here at Chalmers University of Technology are currently working on and trying to find the answer to. And that's all for this time. See you soon.

https://mse.umd.edu/about/what-is-mse

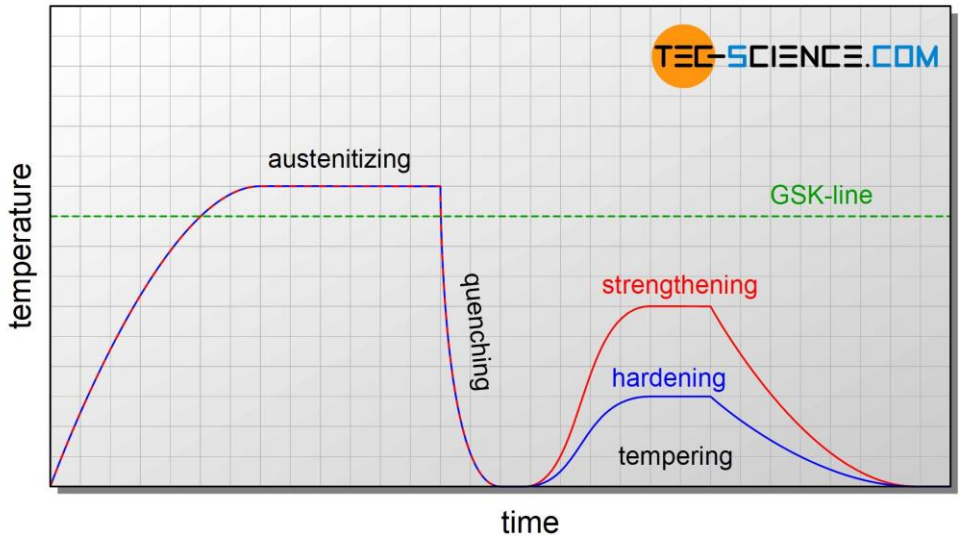


What is Materials Science and Engineering?

Materials Science and Engineering (MSE) combines engineering, physics and chemistry principles to solve real-world problems associated with nanotechnology, biotechnology, information technology, energy, manufacturing and other



https://www.tec-science.com/material-science/heat-treatment-steel/quenching-and-tempering/

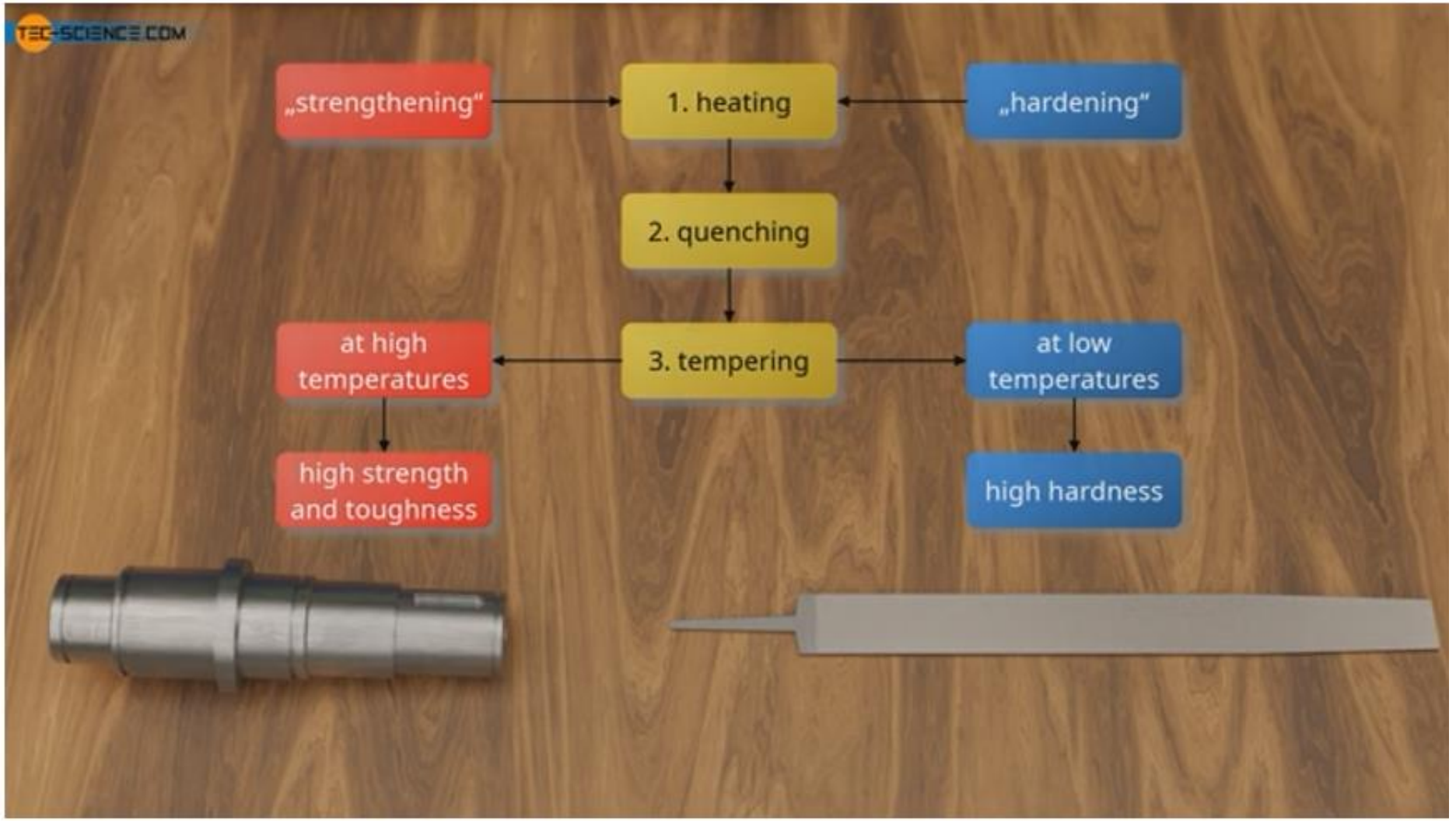


The aim of quenching and tempering is to achieve a hard and wear-resistant surface or to increase the strength of a workpiece.

quenching, **rapid cooling, as by immersion in oil or water, of a metal object from the high temperature at which it has been shaped**. This usually is undertaken to maintain mechanical properties associated with a crystalline structure or phase distribution that would be lost upon slow cooling.

Quenching | Heat Treatment, Hardening & Temperin

Quenching
In materials science, quenching is the rapid cooling of a workpiece in water, gas, oil, polymer, air, or other fluids to obtain certain material properties. A type of heat treating, quenching prevents undesired low-temperature processes, such as phase transformations, from occurring. Wikipedia


„strengthening“
1. heating
„hardening“
2. quenching
at high temperatures
3. tempering
at low temperatures
high strength and toughness
high hardness