

In order to understand and synthesize the impact the materials discussed in this course have on individuals and society, you will need a basic understanding of how scientists, engineers, and sociologists describe materials.

## The Physical Properties of Materials

- Acoustical properties
- Atomic properties
- Chemical properties
- Electrical properties
- Environmental properties
- Magnetic properties
- Manufacturing properties
- Mechanical properties
- Optical properties
- Radiological properties
- Thermal properties

### For most materials, engineers tend to focus on:

- Electrical properties
  - e.g. electrical conductivity
- Environmental properties
  - e.g. environmental stability, corrosion resistance, recyclability, sustainability
- Magnetic properties
  - e.g. coercivity
- Manufacturing properties
  - e.g. hardness, plasticity, castability
- Mechanical properties
  - e.g. yield strength, ductility, hardness, toughness, tensile strength, yield strength, stiffness,
- Optical properties
  - e.g. color, reflectivity, transmittance
- Thermal properties
  - e.g. thermal conductivity, melting point, boiling point

There are also some ways that we describe new materials:

- **Smart** - Smart materials have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields.

## The Social and Cultural Properties of Materials

- **Affordance**

An affordance refers to the physical property of a material or object that becomes salient in a particular social or functional context. In any given application of a material, only some of its properties are affordances for human action and social impacts. So, affordances are the properties of a material that humans find useful in a particular time and place. Affordances will therefore change, even though original properties do not. (Module 2)

- **Entanglement**

Entanglement refers to a state of interdependencies between humans and things: humans are dependent upon things, which are dependent upon other things and also dependent upon humans. Materials do not exist alone, but in entangled relationships with humans and other things. Entanglements are shaped by the properties of materials that include those that are affordances and those that are not. (Module 2)

- **Thing**

A thing is best conceived as an assembly of components. These include properties, materials, and objects. Places, processes, and human activities and intentions also contribute to the thing as an assembly, necessary for the thing to come into existence or to continue to function. (Module 2)

- **Critical**

A critical material is one that (1) has a threatened supply, and (2) is essential to our current technologies. (Module 2)

- **Rare**

Rarity is not the same as scarcity. A material is scarce if there is very little of it in existence. A material is rare if it is very difficult to source and process, not because there is very little of it, but because of difficulties in accessing it in useful quantities. A rare material may be easy to find or be plentiful, but it is not easy to extract. "Rare" also has an archaic meaning of "strange" or "unusual." Example: rare earths. (Module 2)

- **Conflict**

A conflict material is one whose source or method of extraction involves political or social conflicts. Example: blood diamonds. (Module 1)

- **Operational Sequence**

The series of technical steps, decision-making, and social acts involved in the production, use, and discard of materials. (English translation of French term chaîne opératoire, coined by archaeologist André Leroi-Gourhan.) (Module 3)

- **Cultural Significance**

Materials take their meaning from how they are perceived in a society, including their past uses. The ambitions and beliefs of a society (and individual people) can shape how they select and use materials. (Module 5)

- **Symbolism**

The qualities, meaning or purpose that a society attributes to a material. (examples of symbolism might include: gender, power, etc.) (Module 5)

- **Know-How**

This is an informal way to describe the knowledge that is required to process materials. It implies access to expertise and an ability to train people in this knowledge. When we think about the properties of materials, we should also consider who has the know-how to use them in particular ways. (Module 4)

- **Distribution**

The natural distribution/availability of a material around the globe could be considered one of its social properties, because getting access to a material shapes what civilizations can use the material (or alloy it). The distribution of a material also leads to the development of trade routes, political organizations to protect the materials and trade, etc. (Module 4)

- **Creative Destruction**

This term, from business history and economics, refers to how new product/materials innovations (creativity) may replace or alter existing economic structures (destruction). The development of steel created new economic, business, and labor regimes that destroyed those that came before. Creative Destruction is an essential part of a capitalist economy. (Module 7)

- **Throughput**

the rate at which a material can be processed [into a finished product at a factory](#) from start to finish. (Module 7)

- **Vertical Integration**

a [business strategy](#) in which one company [acquires firms in every step](#) in the supply chain for producing and refining a particular material. (Module 7)

- **Horizontal Integration**

a [business strategy](#) in which one company acquires other companies making the same product to increase their market share. (Module 7)

- **Market Share**

The [proportion](#) of all sales of a material made by a single company. (Module 8)

- **Antitrust**

Antitrust law refers to legal restrictions on [market share](#) that work to maintain a certain level of competition among different companies working in the same industry. (Module 8)

- **Coterminous with the Social Network**

The technologies that we build with materials must function in relation to the needs of the groups who employ them. (Module 9)

- **Overlapping Materials**

Different materials may be employed simultaneously for the same use (e.g., writing technologies). We don't abandon one material for the next immediately. Instead, after what might be a costly initiation fee, we may gradually adopt new materials where they work well but also continue using existing materials to meet the needs that they continue to fulfill. (Module 9)

- **Intrinsic value**

The value of a material that resides in it. (Module 5)

- **Extrinsic or exchange value**

The value that another body (such as a government) gives to a material through processing it or manipulating it in a particular way) (Module 5)

- **Marketing**

The framing of a material by emphasizing particular properties, uses, or meanings and illustrating how they connect to the life, values, needs, or desires of the consumer (Module 10)

- **Delegation**

The outsourcing of human tasks to non-humans, such as technologies or materials (Module 11)