Welcome to the Material World
MATTER

Matter is anything that occupies space which may be gas, liquid or solid. Atoms join together to make matter.

• Depending on the type, quantity of atoms and the nature of bonds that engage atoms, stable structures are formed.
• The atomic architecture of these structures determines the gross properties of each kind of material.
MATERIAL CULTURE

Human’s enjoyment, exploitation and eventual explanation of the inner qualities of matter is one of the most fascinating aspect of human history.

Materials have fundamentally determined what human could do at every stage of history.
The DNA “clock” suggests that man emerged as a species distinct from other apes seven million years ago—much later than former estimates. The new measure suggests that man is genetically closer to the chimp than the chimp is to the gorilla.
Few humans can survive in the wild without implements of some kind. Rocks and minerals were important to human beings since the beginning of human history. They were used as

• Tools
• Construction materials
• Decorative objects
• Architecture
• Sculpture
• To extract metals

Our earliest ancestors manufactured stone tools which caused critical changes in their diet and in biological form.
*Homo Habilis* (Man, the handy man) began to appear in East Africa about 2 - 1.5 M years ago. They were probably the first creatures to *make tools*, walked on two legs and had a larger brain size.
PALEOLITHIC AGES (Old Stone Age) 750,000 - 20,000 BP
PALEOLITHIC ART
Complex tools,
Many raw materials
NEOLITHIC REVOLUTION

Beginning of Agriculture and Domestication of Animals

~ 12500 BP
Beginning of urbanization
Once human kind settle in small towns, solved dietary problems by farming and domesticated animals, they had more time to think and experiment with naturally available resources to create new materials.
OBSIDIAN
STONE VESSELS FROM UR MESOPOTAMIA
LAPIS LAZULI
PYROTECHNOLOGY

• Cooking of food 100,000 years ago
• Annealing stone 25,000 years ago
• Baked clay 9,000 BC
• Plaster 9,000 BC
• Smelting of ores 6,000 BC
• Glaze 4,000 BC
• Glass 2,000 BC

CHEMISTRY INTRODUCED BY PYROTECHNOLOGY

• Oxidation: Burning organic material.
• Reduction: Reducing metals from their ores
• Aggregation: Preparation of alloys, pottery
• Heat Separation: Distillation
After mastering pyrothecnology, they realized that they can transform naturally occurring materials into very functional materials.
TRANSFORMATION CLAY INTO POTTERY
POTTERY
METAL CYCLE

ORE

Smelting

METAL

Corrosion

METAL ARTIFACTS

Production
Colorful minerals (rocks) are reduced in furnaces at very high temperatures to yield copper.
OBJECTS THAT CAN BE MADE BY OPEN MOLD CASTING
ANCIENT SILVER

Hittite 2nd Mil. BC

ALACA Höyük GOLD

2500 BC
Ancient glass making using a clay core
Inner structure of materials / properties

Materials have fundamentally determined what humans could do at every stage of history.
Throughout the human history, human kind wanted to know the inner structure of matter. They realized that the inner structure of matter is responsible for all the properties of matter.
UNDERSTANDING MATTER

• Democritus 430 BC: All Matter Consists of invisible Particles called **atoms**

• Aristotle 320 BC: All matter was composed of 5 elements: Aether: which he viewed as a divine substance which made up the stars and planets. This theory lasted for 2000 years.
Structure Determines Properties

• Everything is made of tiny particles called **atoms and molecules**.
• Chemists study these particles, looking at the kinds, numbers, structure, size, how they are bonded to each other which produce varying chemical and physical properties.
• **ELEMENTS** are the forms of matter which cannot be decomposed into substances by chemical reactions.

• They are the basic substances (atoms) from which all matter is composed.

A **COMPOUND or a MOLECULE is a substance** composed of atoms of two or more elements chemically united in fixed proportions. Compounds can be separated only by **chemical means** into their pure components (elements).