



## **Chapter Ten: Properties of Matter**

- **10.1 Density**
- **10.2 Properties of Solids**
- **10.3 Properties of Fluids**
- **10.4 Buoyancy**



## Chapter 10.2 Learning Goals

- **Distinguish chemical properties from physical properties of matter.**
- **Identify differences between crystalline and amorphous solids.**
- **Explain how the arrangement of atoms and molecules in solids determines their properties.**



## 10.2 Properties of Solids

- Different kinds of matter have different characteristics.
- Characteristics that can you observe directly are called physical properties.
- Physical properties include color, texture, density, brittleness, and state (solid, liquid, or gas).



Ex. Iron is solid at room temp.



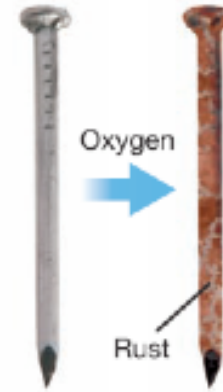
## 10.2 Properties of Solids

- A physical change is any change in the size, shape, or phase of matter in which the identity of a substance does not change.
- For example, when water is frozen, it changes from a liquid to a solid.



## 10.2 Properties of Solids

- Properties that can only be observed when one substance changes into a different substance are called **chemical properties**.
- Any change that transforms one substance into a different substance is called a **chemical change**.



Iron reacts with oxygen to form iron oxides.



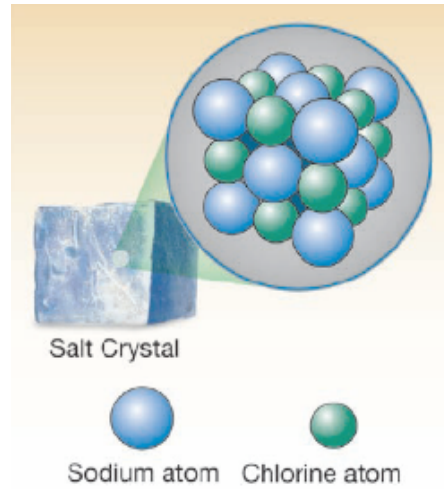
## 10.2 Properties of Solids

The atoms or molecules in a solid are arranged in two ways.

1. If the particles are arranged in an orderly, repeating pattern, the solid is **crystalline**.
2. If the particles are arranged in a random way, the solid is **amorphous**.



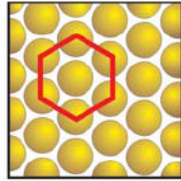
## 10.2 Properties of Solids



- **Examples of crystalline solids include salts, minerals, and metals.**



## 10.2 Properties of Solids



**Crystalline**  
(repeating pattern)



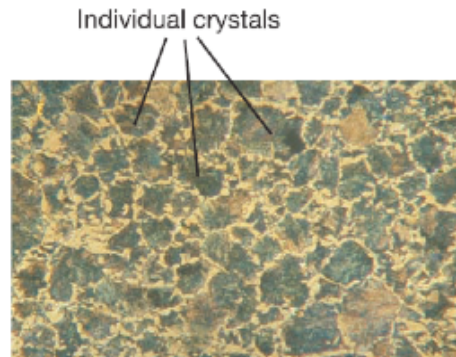
- The atoms or molecules in amorphous solids are randomly arranged.
- Examples of amorphous solids include rubber, wax, and glass.





## 10.2 Properties of Solids

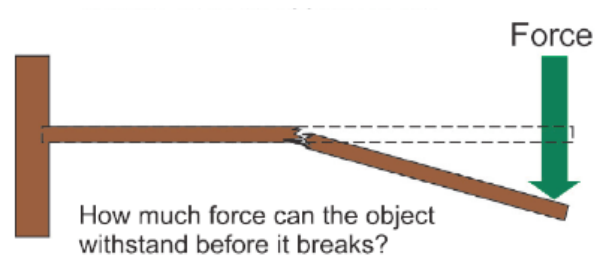
- **Metals don't look like "crystals" because solid metal is made from very tiny crystals fused together in a jumble of different orientations.**





## 10.2 Mechanical properties

- **“Strength”** describes the ability of a solid object to maintain its shape even when force is applied.





## 10.2 Mechanical properties

- **Tensile strength is a measure of how much stress a material can withstand before breaking.**





## 10.2 Mechanical properties

- **Hardness** measures a solid's resistance to scratching.



Steel



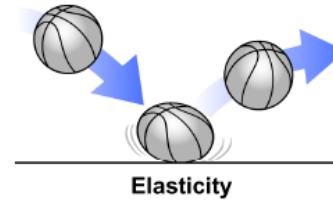
Aluminum

**How might you compare the hardness of these two metals?**



## 10.2 Mechanical properties

- **Elasticity** describes a solid's ability to be stretched and then return to its original size.



- **Brittleness** is defined as the tendency of a solid to crack or break before stretching very much.





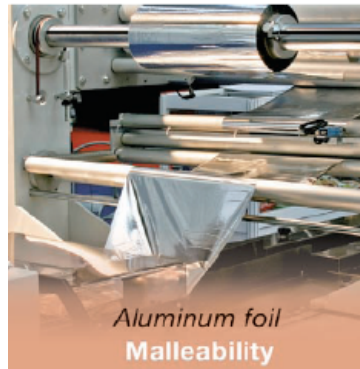
## 10.2 Mechanical properties

- A ductile material can be bent a relatively large amount without breaking.
- The ductility of many metals, like copper, allow them to be drawn into wire.





## 10.2 Mechanical properties

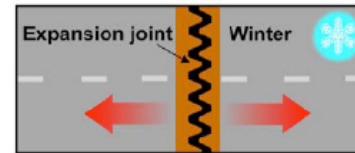
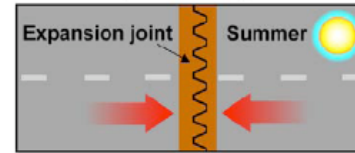


- **Malleability** measures a solid's ability to be pounded into thin sheets.
- **Aluminum** is a highly malleable metal.



## 10.2 Mechanical properties

- **Almost all solid materials expand as the temperature increases.**
- **The increased vibration makes each particle take up a little more space, causing thermal expansion.**



Sidewalks and bridges have grooves that allow for thermal expansion.