What's the Matter with Matter!

1

1

The Properties of Matter!

Definition:

"Matter is anything that takes up space and mass"

2

2

The Properties of Matter!

Physical Properties

The physical state of matter and the relationship between the particles contained within it.

3

3

The Properties of Matter!

Physical Properties

Physical properties **will not** be affected by the amount of material.

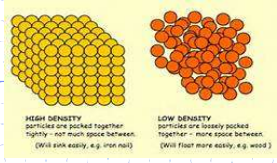
4

4

The Properties of Matter!

Types of Physical Properties

Density - "how particles are packed"



5

5

The Properties of Matter!

Types of Physical Properties

Malleability – "ability to be hammered into shape"

6

6

The Properties of Matter!

Types of Physical Properties

Ductility- "ability to be stretched into thin wires"

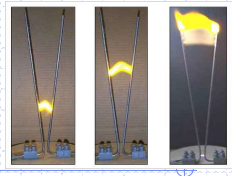
7

7

The Properties of Matter!

Types of Physical Properties

Conductivity- " ability to transfer heat or electricity between its particles"



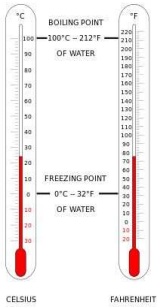
8

8

The Properties of Matter!

Physical Properties

1. **Boiling point**
2. **Melting point**
3. **Freezing point**



9

9

The Properties of Matter!

Physical Change

"Change that occurs in a material without changing its identity"

10

10

The Properties of Matter!

Examples of Physical Change

- **Ice**
- **Water**
- **Steam**

11

11

Examples of Physical Changes

- crushing a can
- melting an ice cube
- boiling water
- breaking a glass
- shredding paper
- chopping wood
- dissolving sugar or salt in water

12

12

The Properties of Matter!

Chemical Properties Defined

"How matter acts in the presence of other material"

13

13

The Properties of Matter!

Chemical Change (reactivity)

"Identity of the material changes and becomes different both in its properties and composition."

14

14

Examples of Chemical Changes

- rusting of iron
- combustion (burning) of wood
- metabolism of food in the body
- mixing baking soda and vinegar to produce carbon dioxide gas
- explosion of fireworks
- milk going sour

15

15

The Properties of Matter!

Chemical Properties

Chemical properties will be affected by the amount of material.

16

16

Combustion

- A reaction between a fuel and an oxidant, usually atmospheric oxygen, that produces oxidized material (ash) and a gaseous product (smoke).
- This is a chemical change

17

17

Flame Tests - Metals and heat

- The heat of a flame excites the electrons of metal ions, causing them to emit visible light.
- When the heat is removed the metal ion returns to its prior state. Therefore, this represents a physical change.
- This should not be confused with combustion which is a chemical change.

18

18

Chemical Indicators

- A chemical indicator is a substance that changes color in the presence of an acid or alkaline material.
- Since the acid or alkaline material is not changed but just colored, this is not considered a chemical change.

19

19

Does it Matter?

20

20

The Division of Matter!

"Matter can be defined into two categories:

- Pure substance
- Mixture

21

21

The Division of Matter!

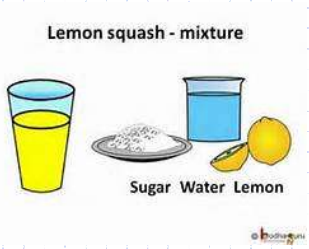
"Matter can be defined into two categories:

- Pure substance - Gold
- Mixture - Lemonade

22

22

The Division of Matter!



23

23

The Division of Matter!

"Mixtures can further be defined into two categories:

- Heterogeneous = Oil and vinegar
- Homogeneous = Salt and water

24

24

The Division of Matter!

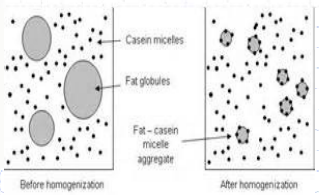
Heterogeneous

Homogeneous

25

25

The Division of Matter!



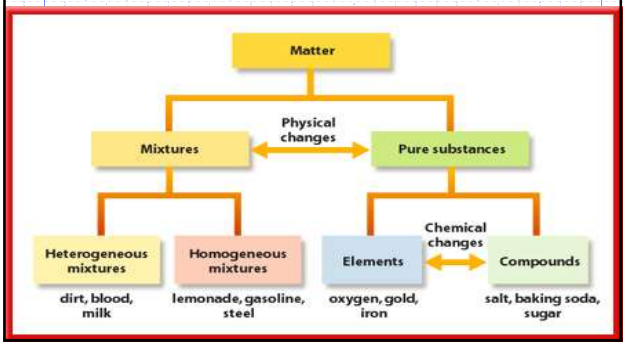
Homogenized Milk

Breaks down and blends fat globules in milk

26

26

The Division of Matter!



27

27

The Elements!

28

28

The Element's!

"The purest and simplest form of a substance is known as an element"

29

29

The Element's!

Are made up of small particles called:

Atoms

30

30

Types of Elements!

- Monatomic
- Diatomic
- Polyatomic

31

31

Types of Elements!

Monatomic

"Atoms that do not naturally combine or bond together with other elements"

32

32

Types of Elements!

Monatomic

- Neon (Ne)
- Helium (He)
- Argon (Ar)

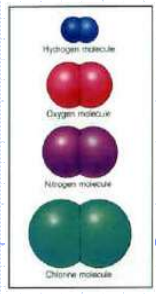
33

33

Types of Elements!

Diatomic

"Atoms that naturally bind into two atom units"



34

34

Types of Elements!

Diatomic

- Oxygen (O_2)
- Hydrogen (H_2)
- Nitrogen (N_2)

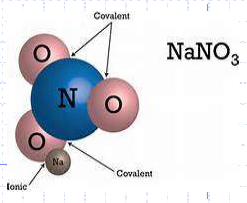
35

35

Types of Elements!

Polyatomic

"Atoms that naturally bind into more than two atom units"



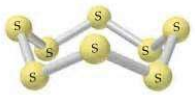
36

36

Types of Elements!

Polyatomic

Sulfur (S_8)



37

37

The Element's and their Symbols!

38

38

Periodic Table of the Elements

39

39

Symbol Representation!

- First Letter of their name
- Second lower-case letter in the name to avoid confusion with other elementals.

40

40

Symbol Representation!

- Hydrogen - H
- Helium- He
- Carbon - C
- Calcium - Ca

41

41

Symbol Representation!

- Elements identified in ancient times used Latin or Greek in their naming
- Some elements are identified by where they were found or by whom.

42

42

Symbol Representation!

- Copper (Cuprium- Cypress)
- Irridium (Rainbow)
- Curium
- Californuium
- Helium (Greek Sun)
- Bromine – (Greek for stench)

43

43

Compounds and their Formulas!

44

44

Compounds!

- "The result of two or more atoms, from different elements, that have been chemically bonded together"

45

45

Example!

- Ammonia -NH_3
- Rust - Fe_2O_3
- Sucrose – $(C_{12}H_{22})_{11}$
- Salt - NaCl
- Water - H_2O

46

46

Coefficient and Subscripts!

- Subscripts - number of atoms or groups of atoms in a formula.
  - $CaBr_3$
  - H_2O
  - CO_2

47

47

Coefficient and Subscripts!

- Coefficient - Number as it relates to the entire group of an element.
  - $3CaBr_3$
  - $4H_2O$
  - $2CO_2$

48

48

Energy in Matter!

49

49

Chemical Reactions!

- Exothermic - release energy
- Endothermic - absorb energy

50

50

Chemical Reactions!

Exothermic Endothermic

51

51

Energy Conservation

Thermodynamics :

"Study of the flow of energy, especially heat energy."

52

52

The First Law of Thermodynamics

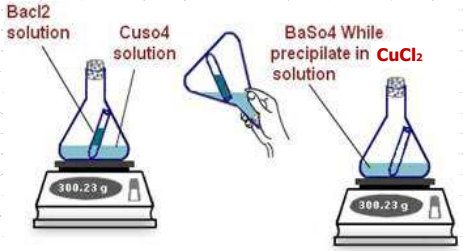
(Law of conservation of mass energy)

"Matter and energy can neither be created nor destroyed only converted from one form to another"

53

53

Law of conservation of mass energy



54

54

The Second Law of Thermodynamics

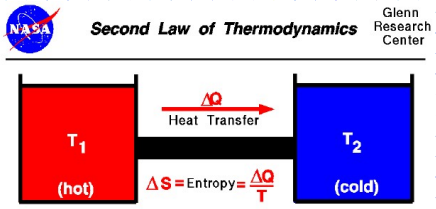
(Part 1 - Law of degradation of mass energy)

"During any energy transformation some energy becomes unusable or dispersed"

55

55

Law of degradation of mass energy (part 1)



There exists a useful thermodynamic variable called entropy (S). A natural process that starts in one equilibrium state and ends in another will go in the direction that causes the entropy of the system plus the environment to increase for an irreversible process and to remain constant for a reversible process.

$S_f = S_i$ (reversible) $S_f > S_i$ (irreversible)

56

56

The Second Law of Thermodynamics

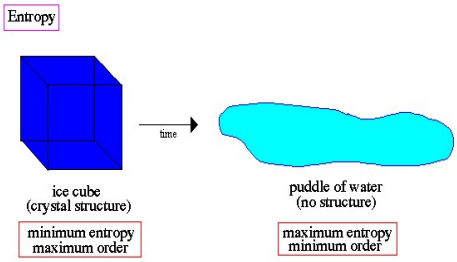
(Entropy – part 2)

"Every system left to itself will tend toward maximum disorder (entropy)"

57

57

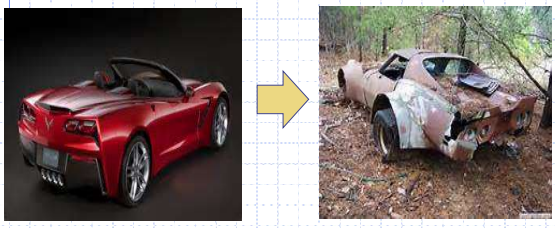
Entropy – part 2



58

58

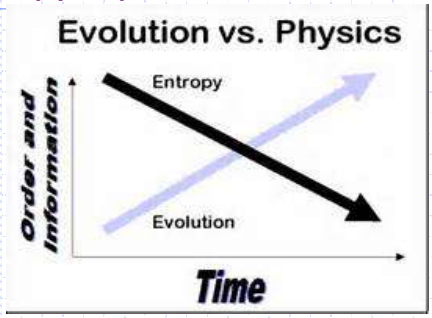
Entropy – part 2



59

59

Entropy – part 2



60

60

Chaos Theory

Non organized behavior never repeats and it continues to manifest the effects of any small change; therefore, any prediction of a future state in a given system that is non-organized is impossible.

No events ever repeats exactly!

61

61

Chaos Theory and Entropy

62

62

Chaos Theory and Entropy

63

63

Energy in Matter!

64

64

Energy Measurement

British Thermal Unit (BTU)

"Amount of heat required to raise one pound of water one degree Fahrenheit"

65

65

Energy Measurement

Calorie (Cal)

"Amount of heat required to raise one gram of water one degree Celsius"

66

66

Energy Measurement Scales

67

67

Energy Measurement Scale

Celsius or Centigrade Scale (C)

Freezing point of water
= 0 deg. C

Boiling point of water
= 100 deg. C

68

68

Energy Measurement Scale

Kelvin (K)

Absolute Zero = 0 K

Freezing point of water
= 273 K

69

69

Energy Measurement Scale

Centigrade conversion to Kelvin !

K = C + 273

70

70

States of Matter

Matter is composed of:
"Submicroscopic particles that are in constant motion"

71

71

States of Matter

ENERGY = SHAPE

72

72

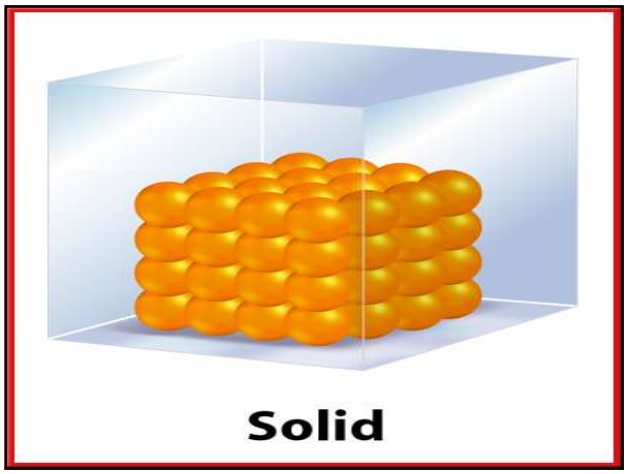
States of Matter

Solid

"Definite shape and volume and packed close together"

73

73



74

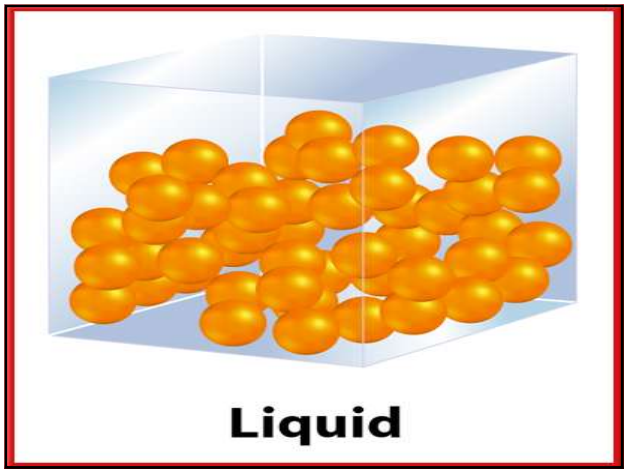
States of Matter

Liquid

"Definite volume, packed close together, takes shape of container, difficult to compress"

75

75



76

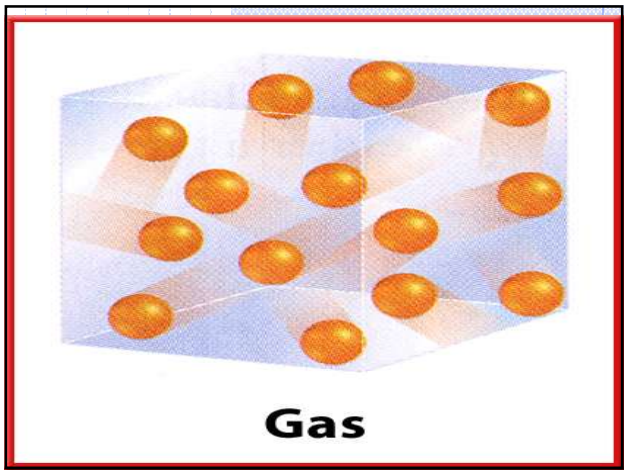
States of Matter

Gas

"Restricted by container in regards to shape and volume, easy to compress"

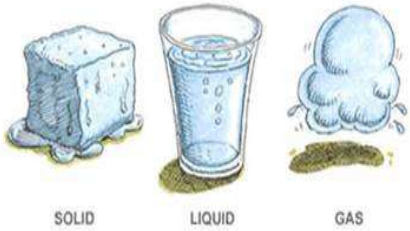
77

77



78

States of Matter



79

79

States of Matter

Plasma

"Sub-atomic particles traveling at high speed, no shape or volume"

80

80

Examples of Plasma

- Gases in discharge tubes (fluorescent lamps and neon signs)
- Welding arcs
- Lightning
- Aurora Borealis
- interstellar gas clouds
- The fireball made by a nuclear weapon
- Comet tails

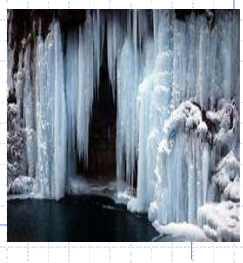
81

81

Changes in Matter

Freezing

"Phase change from a liquid to a solid"



82

82

Changes in Matter

Freezing

83

83

Changes in Matter

Melting

"Phase change from a solid to a liquid"

84

84

Changes in Matter

Melting

85

85

Changes in Matter

Condensation

"Phase change from a gas to a liquid, also known as liquefaction"

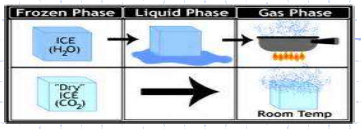
86

86

Changes in Matter

Sublimation

"Phase change from a solid to a gas without passing through the liquid phase"



87

87

Changes in Matter

Deposition

"Phase change from a gas to a solid without passing through the liquid phase"

88

88

Changes in Matter

Example of Sublimation

Dry Ice (CO_2)

89

89

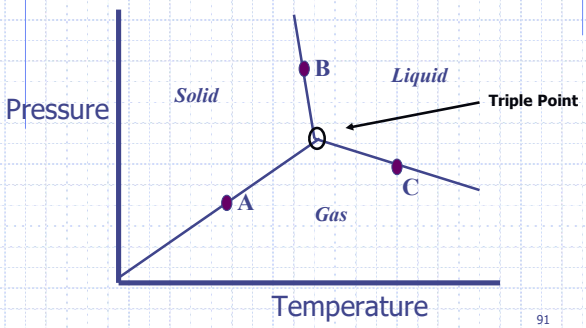
States of matter

- Triple Point
  - Point at which all three states of matter exist simultaneously.

90

90

Pressure Phase Diagram



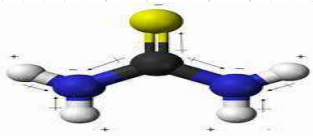
91

91

States of Matter

Forces

Intermolecular forces – polarity and charges of the elements determine their ability to attract each other.



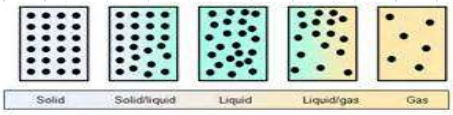
92

92

States of matter

Kinetic theory

Particles of matter are in constant motion, the property of that matter is a result of their motion



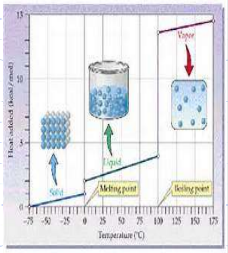
93

93

States of Matter

Energy and Matter changes

- **Energy changes intermolecular forces**
- **Temperature does not change until all inter-molecular forces have been broken**



94

94

States of Matter

Energy and Matter changes

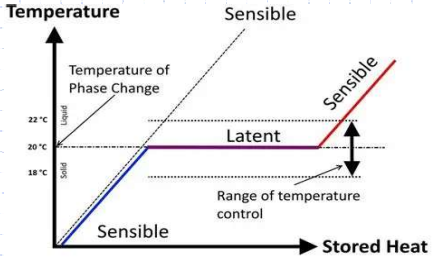
- **Sensible heat – temperature change**
- **Latent heat – energy required for phase change**

95

95

States of Matter

Energy and Matter changes



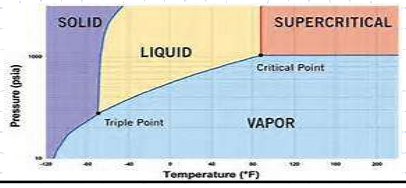
96

96

States of Matter

Critical temperature

The temperature above which a compound can not stay as a liquid



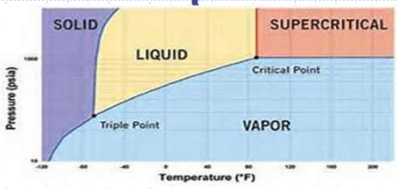
97

97

States of Matter

Critical Pressure

The pressure required to keep a liquid at critical temperature.



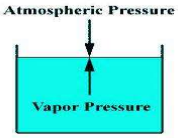
98

98

States of Matter

Vapor Pressure

The point at which a compounds internal pressure exceeds atmospheric pressure so it may go into a gaseous state.



99

99

Solids

Crystals

Orderly and regular arrangement of particles due to electrical charges

100

100

Solids

Amorphous Solids

Random arrangement of particles

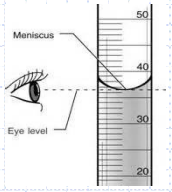
101

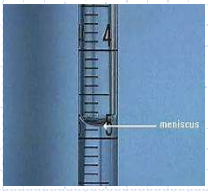
101

Liquids

Container Attraction

Attractive forces of glass will overcome the attractive forces of a liquid





102

102

Liquids

Surface tension

Unbalanced forces at the surface of the liquid

103

103