# Matter

- ***Matter*** is any substance that has mass and occupies volume.
- Matter exists in one of four physical states:
  1. Solid
  2. Liquid
  3. Gas
  4. Plasma

# Kinetic Molecular Theory

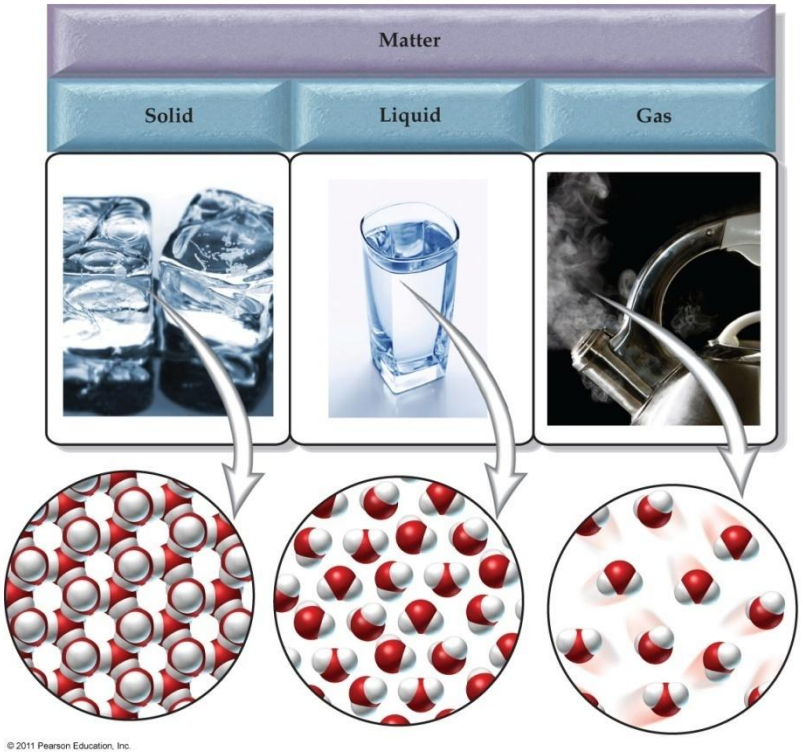
- 1. All matter is composed of small particles (atoms, molecules, or ions)
- 2. These particles are in constant random motion.
- 3. These particles collide with each other and with the walls of their container.

# States of Matter

- Based on:
  - Particle Arrangement
  - Energy of Particles
  - Distance Between Particles

# Physical States of Matter

| | Solid | Liquid | Gas | Plasma |
|---|---|---|---|---|
| Shape | | | | |
| Volume | | | | |
| Compressibility | | | | |
| Energy | | | | |



# Solids

- In a solid, the molecules of matter are tightly packed together.
- Solids have a **definite, fixed shape.**
- Solids **cannot be compressed, and have a definite volume.**
- Solids have the **least amount of kinetic energy** of the states of matter (this may potentially change in the future as new states of matter are discovered).

# Solids

## Crystalline

Highly organized arrangements of atoms, ions, or molecules.

Examples: Diamond, salt, metals, sugar

## Amorphous

- Little to no organization of the atoms, ions, or molecules.
- Examples: wax, glass, plastic, rubber

# Liquids

- In a liquid, the particles of matter are loosely packed and are free to move past one another.
- Liquids have an **indefinite shape** and assume the shape of their container.
- Liquids **cannot be compressed and have a definite volume.**
- Liquids have **less energy than gases, but more than solids.**

# Two Properties of Liquids

- **Viscosity—** a liquids resistance to flow
- **Surface Tension—** a force that acts on the particles at the surface of a liquid.

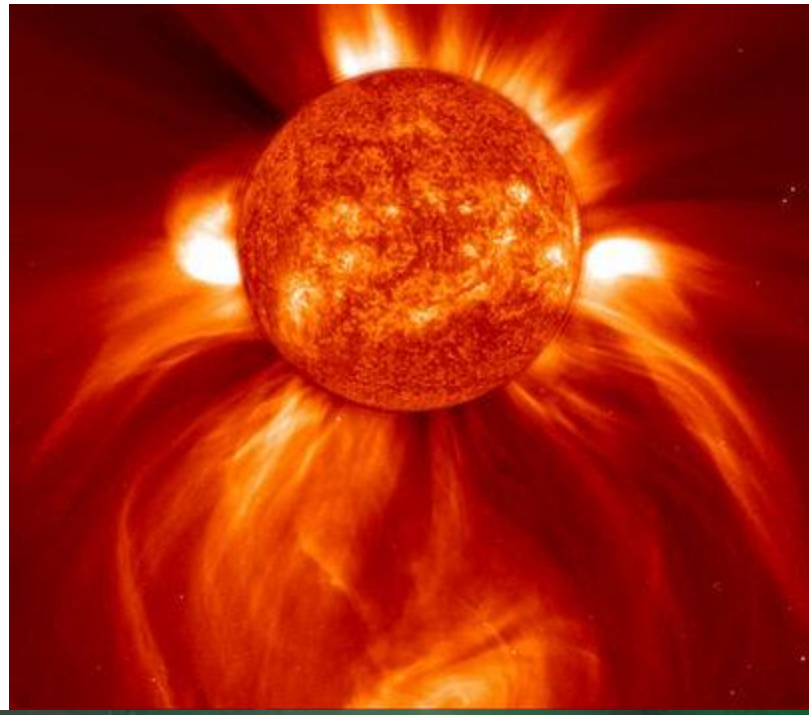
- **Why do liquids vary in these two properties?**

# Gases

- In a gas, the particles of matter are far apart and uniformly distributed throughout the container.
- Gases have an **indefinite shape,** and assume the shape of the container.
- Gases **can be compressed and have an indefinite volume.**
- Gases have **more energy compared to** liquids and solids.

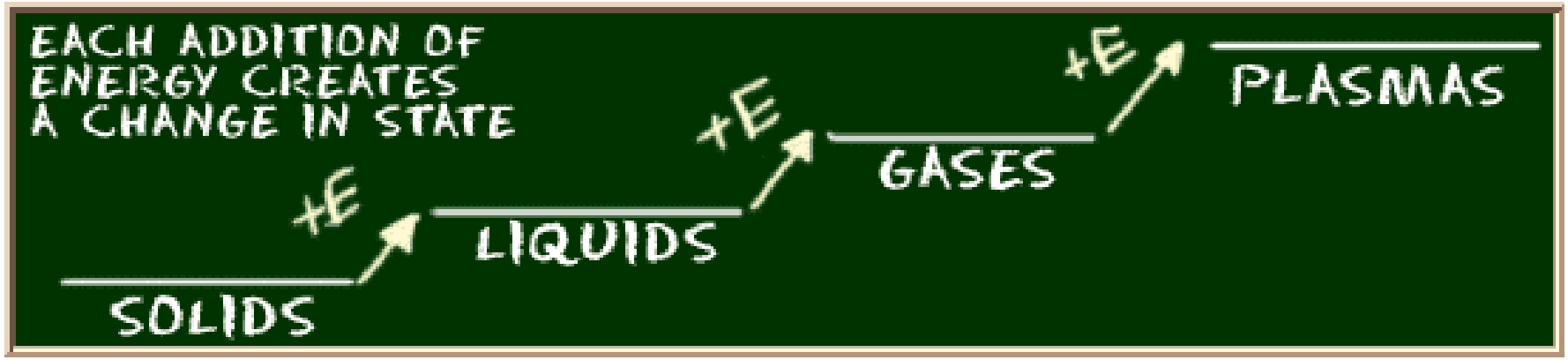
# Plasma

- Plasma is an ionized gas (a gas with a positive or negative charge).
- A plasma particle is a very good conductor of electricity and is affected by a magnetic field.
- Plasma, like gases **have an indefinite shape and volume.**
- Plasma has the **highest kinetic energy**.
- Plasma is the most common state of matter in the universe (fire, the sun, lighting, Northern Lights, neon signs, fluorescent lights, etc).



## Making Plasma in the Microwave

# Changes in Physical States




**What factors cause matter to change from one state to another?**

# Changes of State

- All changes of state are physical changes. Why?

- **Endothermic**—the substance gains energy from the environment (feels cold).

- **Exothermic**—the substance releases energy to the environment (feels hot).

# Solid ↔ Liquid Phase Changes

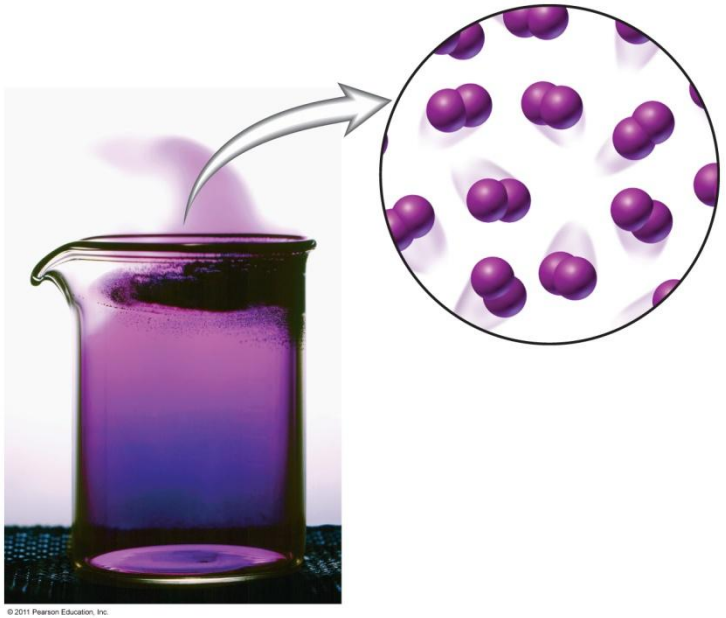
- When a solid changes to a liquid, the phase change is called ***melting***.
- When a liquid changes to a solid, the phase change is called ***freezing***.

# Liquid ↔ Gas Phase Changes

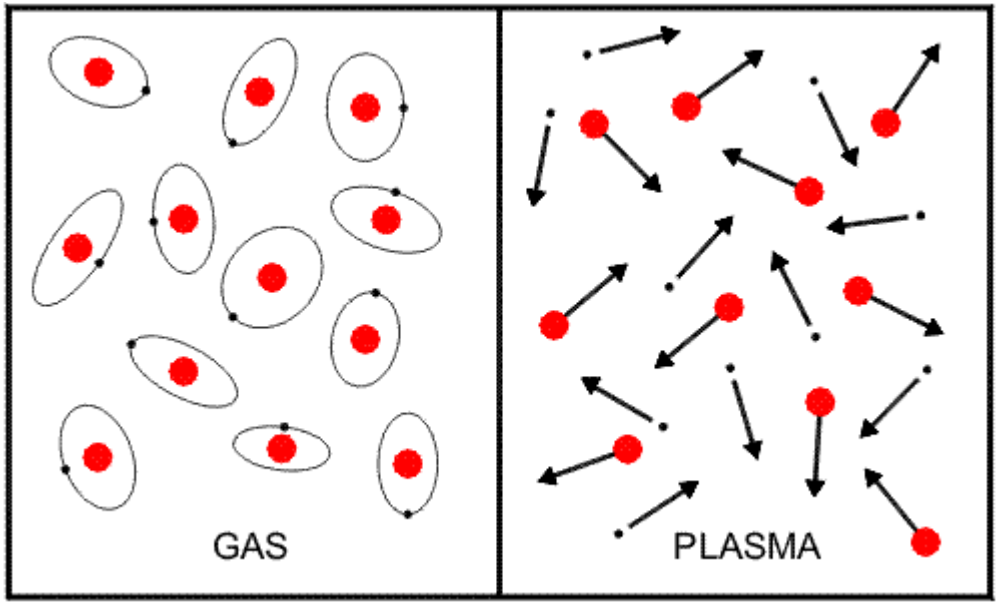
- When a liquid changes to a gas, the phase change is called ***vaporization***.
- When a gas changes to a liquid, the phase change is called ***condensation***.

# Solid ↔ Gas Phase Changes

- When a solid changes directly to a gas, the phase change is called ***sublimation***.
- When a gas changes directly to a solid, the phase change is called ***deposition***.



# Gas ↔ Plasma Phase Changes

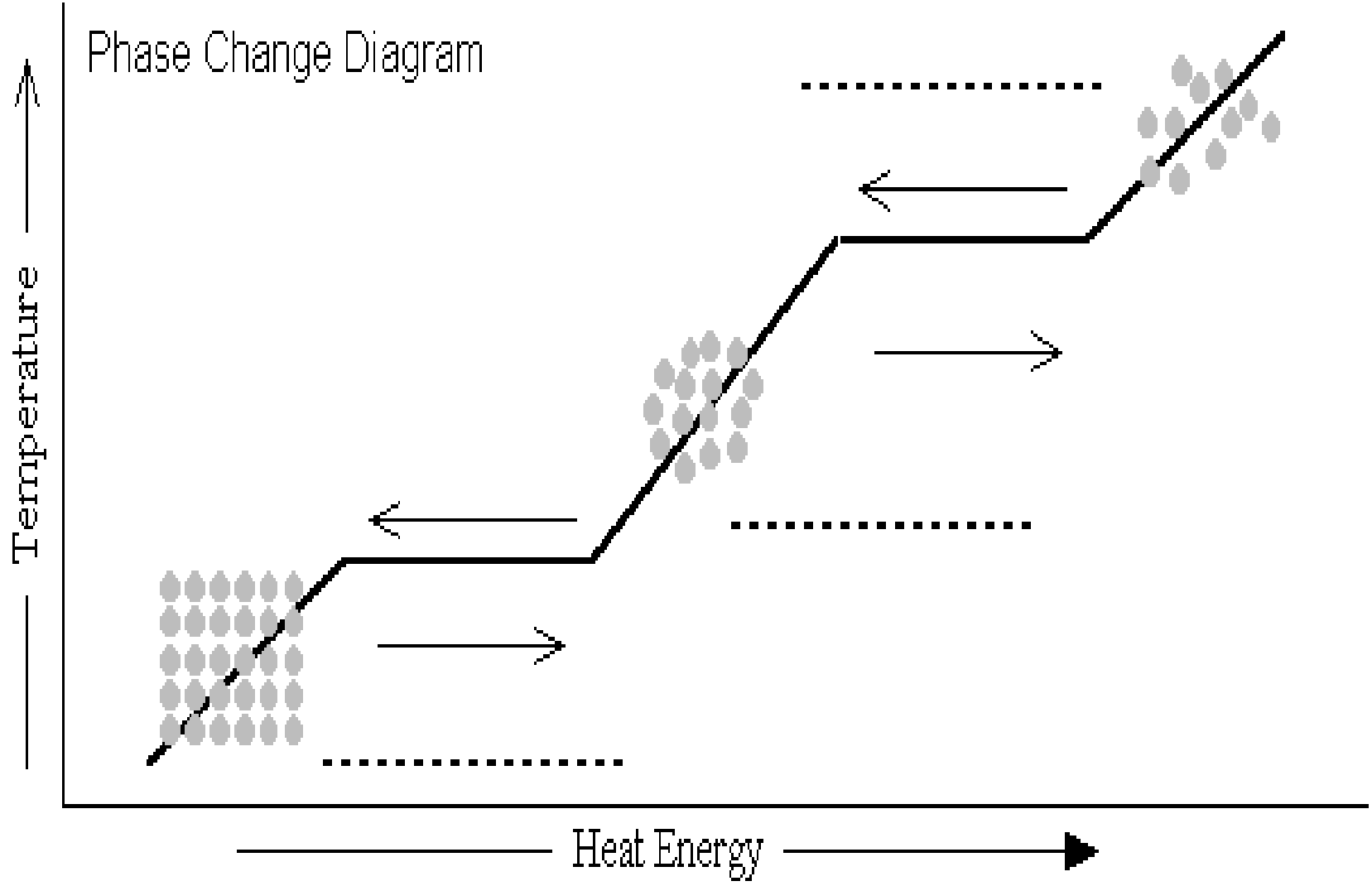



- When a gas changes to plasma the change is called ***ionization.***

- When plasma changes to a gas the change is called ***recombination.***

# Summary of Phase Changes

# Phase Change Diagram



# Boiling Pt

- Which substance has a lower boiling pt, saltwater or distilled water? Explain, to the best of your knowledge, why one boils at a lower temperature.