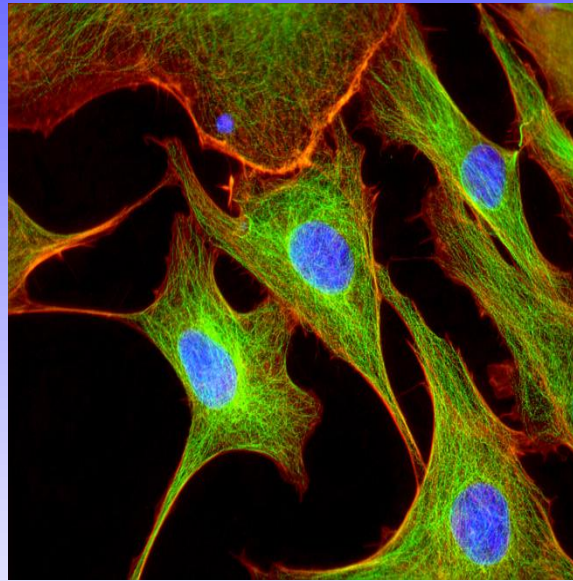
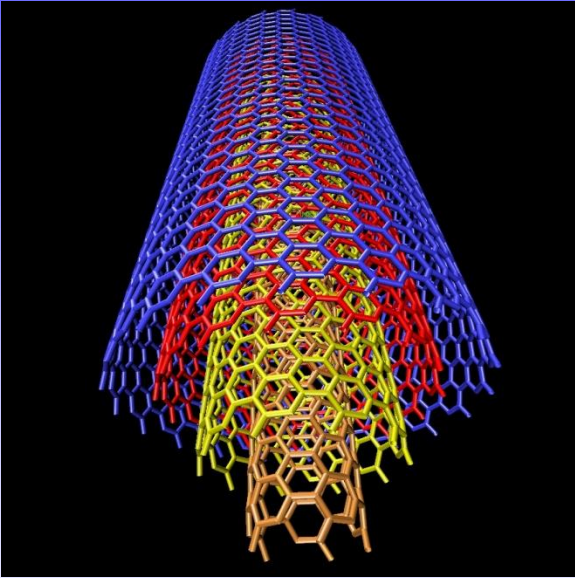


States of Matter



Auburn Mountainview

Karl Steffin, 2001

7/29/2026

By end of this lesson, I can...

- **A.1 Create and/or evaluate models that illustrate how the motion and arrangement of particles differ among solids, liquids, and gases.**
- **A.2 Describe how the properties of solids, liquids, and gases are related to particle arrangement.**
- **A.3 Create and/or evaluate models that illustrate how changes in temperature influence the motion of particles in solids, liquids, and gases.**
- **B.1 Justify the choice of equipment used to make a measurement, based on precision.**
- **B.2 Record measured values to the proper experimental precision.**
- **C.1 Create and/or evaluate particulate and graphical models representing the density of pure substances.**
- **C.2 Explain the relationship between the density and the arrangement of particles within a pure substance.**
- **C.3 Perform calculations relating to the density of pure substances.**

States of Matter

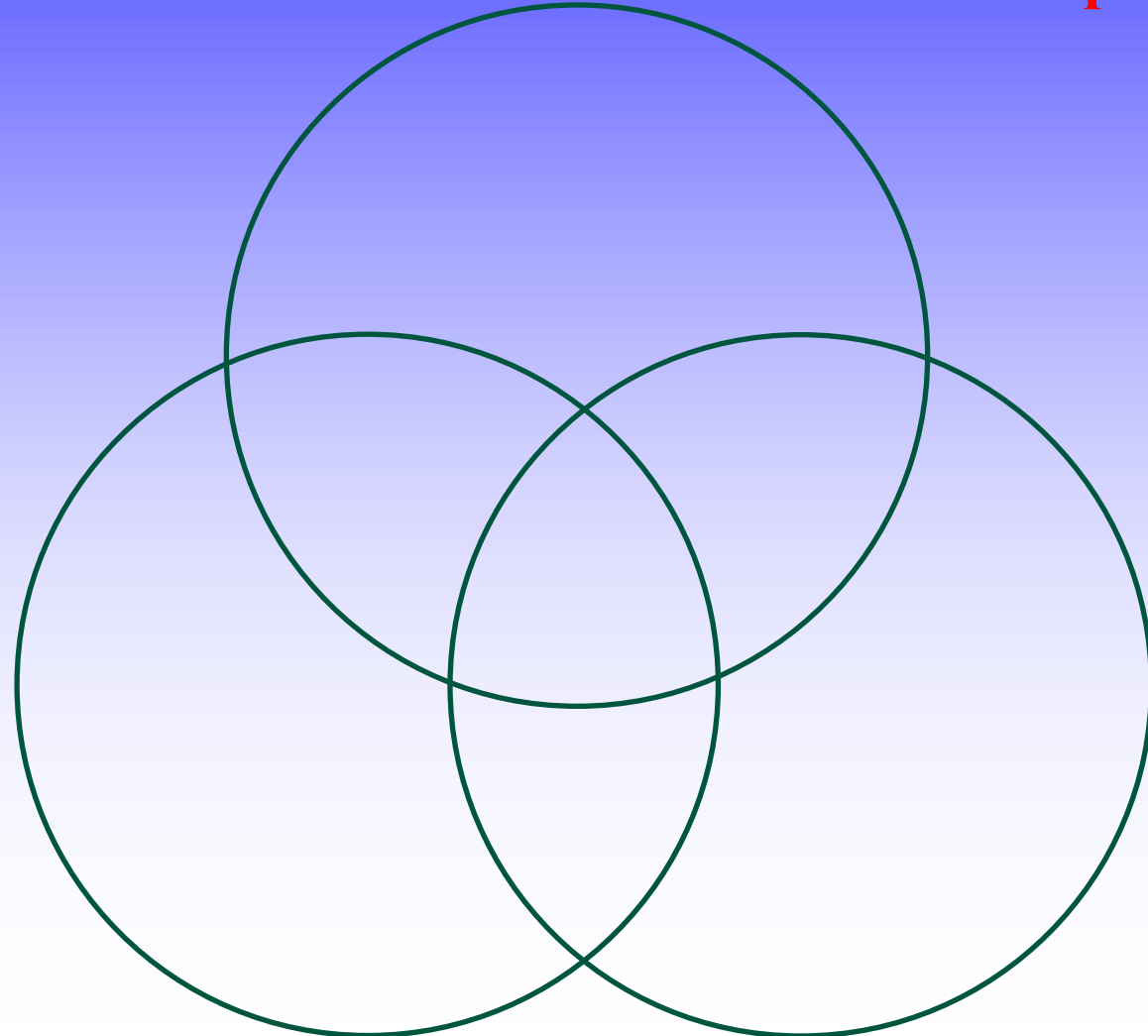
Write this table on the top half of a new page.

Solid or Liquid or Gas?

Fills any container you put it in	Flows from one container to another	Has mass
Takes the shape of the container	Has a fixed shape	Particles are spaced very close together
Often feels hard to the touch	Particles are spaced somewhat close together	Particles are spaced far apart
Does not flow	Particles are arranged in an organized way	Particles are arranged randomly
		

States of Matter

Draw this on the bottom half of the same page



Matter: Pure Substances



- Elements are atoms with a set number of protons. (Gold)

or



- Compounds are two or more different atoms bonded together. (Quartz)

Matter: Mixtures

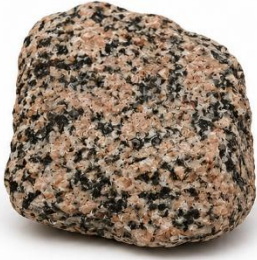
Three Heterogeneous Mixtures

1. Salad



The different ingredients are visible and can be easily separated.

2. Granite



Different minerals are visible in the rock and can be separated physically.

3. Trail Mix



The nuts, raisins, and chocolate pieces are visible and can be easily separated.

Three Homogeneous Mixtures

1. Salt Water



The salt is evenly dissolved in the water. You cannot see it and it does not settle out.

2. Sugar Water



The sugar is evenly dissolved in the water. You cannot see it and it does not settle out.

3. Air



Gases in the air (like nitrogen, oxygen, and carbon dioxide) are mixed evenly. You cannot see them and they do not separate out.

- **Homogeneous: Two or more compounds (not bonded) together in equal proportions.**

or

- **Heterogeneous: Two or more compounds or atoms (not bonded) together in unequal proportions.**

Changing Matter

- **Physical: DO NOT alter the identity.**
 - Phase Changes (Increasing/Decreasing Energy)
 - Magnetic (Temporary addition or removal)
 - Shape Changes (Molding, Drawing, Pounding)
 - Mixing/Crystallizing (Salt + Water, Carbon → Diamond)
 - Breaking (Tear, Crush, Bend)
- **Chemical: Alter the identity.**
 - Oxidization/Reduction (Rust, Tarnish, Burn)
 - Cooking (Denaturing Proteins)
 - Organic (Photosynthesis, Ripening, Rotting)
 - Reacting (Synthesize, Decompose, Replace)



Melting



Shredding



Boiling



Chopping



Combustion



Rotting



Rusting



Digestion

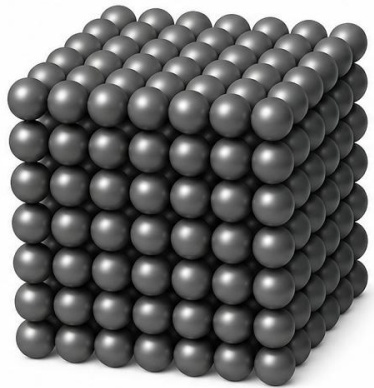
Mass and Density

- **Mass:** quantity of matter in an object (kg)
- **Volume:** quantity of space that matter occupies (m³)
- **Density:** the relationship between mass and volume of an object (kg/m³)

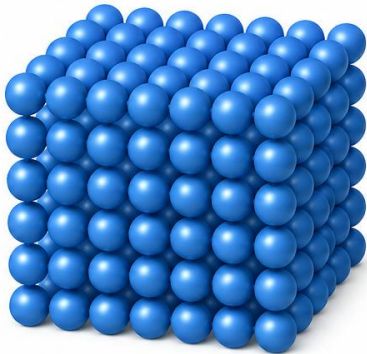
For any substance $D = \frac{m}{V}$.

Particle look at Density

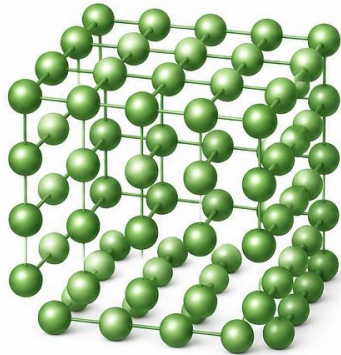
Three Solids of Different Densities



High Density



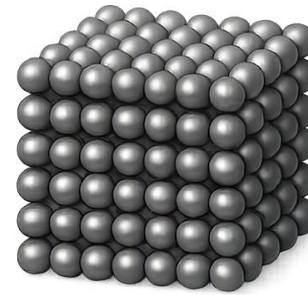
Medium Density



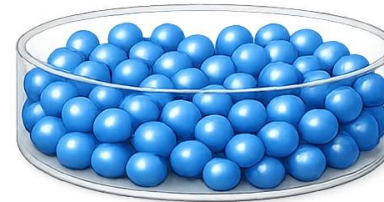
Low Density



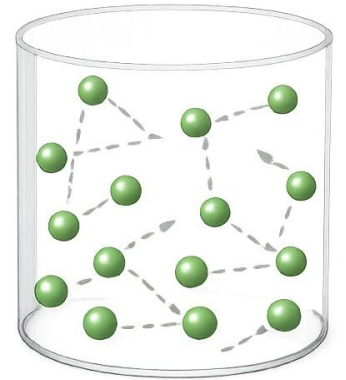
Differences in Densities Between the Three States of Matter



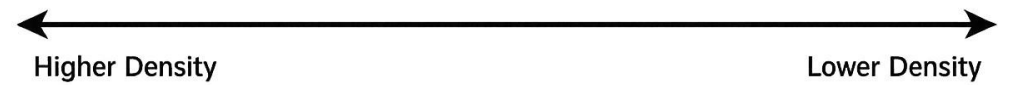
Solid



Liquid



Gas





Density Example

- What mass of water is needed to fill an Olympic size pool (50-m x 25-m, 3.0-m deep)?

$$D = \frac{m}{V}$$

$$1000 - \frac{kg}{m^3} = \frac{m}{3750 - m^3}$$

$$m = 3,750,000 - kg$$

$$V = l \cdot w \cdot h$$

$$V = 50 - m \cdot 25 - m \cdot 3 - m$$

$$V = 3750 - m^3$$

$$D = 1000\text{-kg/m}^3$$

$$m = ?$$

$$V = 3750\text{-m}^3$$

$$l = 50\text{-m}$$

$$w = 25\text{-m}$$

$$h = 3\text{-m}$$

$$m = 3.8 \times 10^6\text{-kg}$$

Density Example Ratios

- Comparisons (ratios) can bridge the gap between very big and very small numbers.
- Compare the mass of the pools water to the mass of a Boeing 747 (162400-kg).

$$R = \frac{m_{pool}}{m_{747}}$$

$$R = \frac{3,750,000 - kg}{162,400 - kg}$$

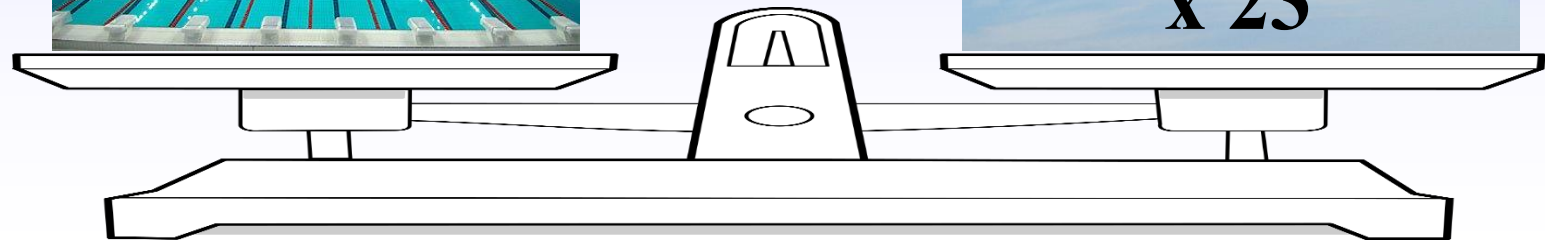
$$R = 23$$

$$m_{pool} = 3.75 \times 10^6 - kg$$

$$m_{747} = 1.62 \times 10^5 - kg$$

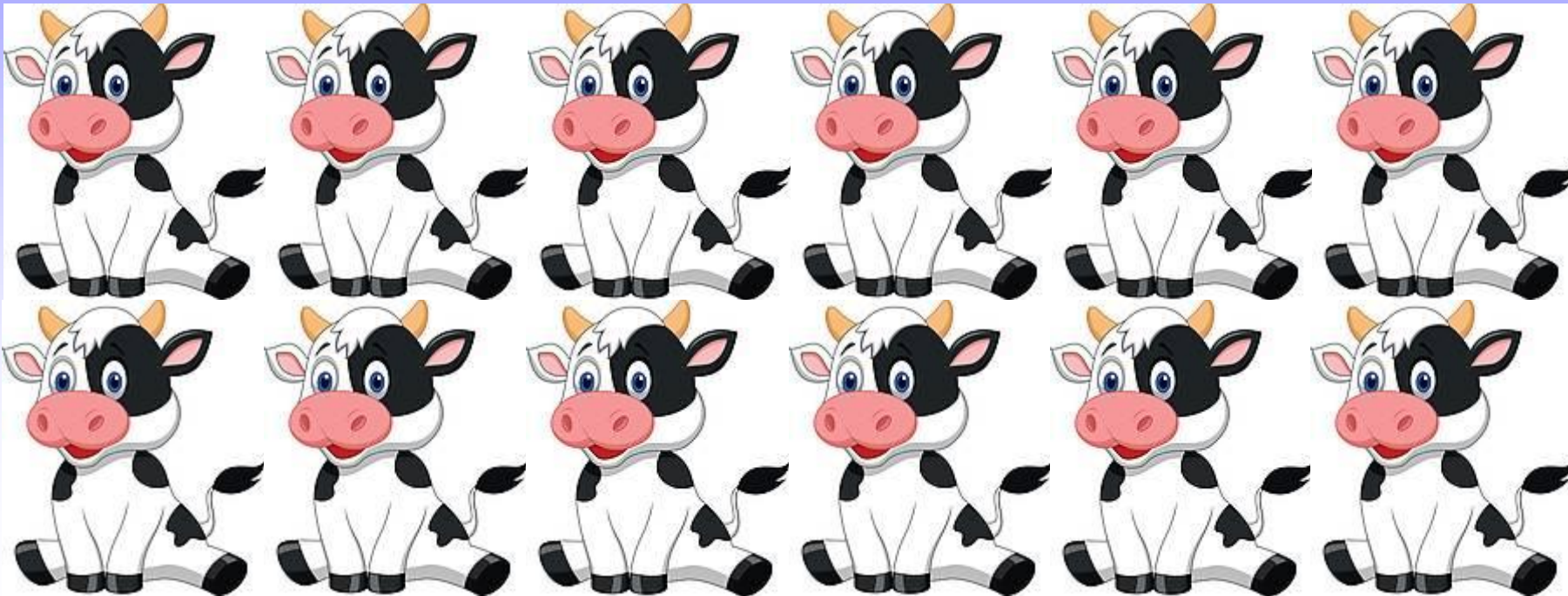


x 23



Self Check

- I measure that there are 15 cows on this page... do an Error Analysis (EA).



**Leave space under
question to solve in
class**

Self Check

- What percentage of the animals have feathers?



**Leave Space under
question to solve in
class**