

# **N4 – Properties, Changes, and Types of Matter**

**Target:** I can classify matter and types of changes to matter.

Link to YouTube Presentation: [https://youtu.be/gQ64-kFWW\\_Q](https://youtu.be/gQ64-kFWW_Q)

# Properties of Matter

## Extensive properties

Depend on the **AMOUNT** of matter that is present.

- Volume
- Mass
- Energy Content  
(think Calories)

## Intensive properties

Depend only on the **TYPE** of matter present,  
*not the amount* present

- Melting point
- Boiling point
- Density

**Which of the following is  
an EXTENSIVE property?**

**AMOUNT**

- A** It is a solid at 25 °C.
- B** It has a density of 1.38 g/cm<sup>3</sup>.
- C** It melts at 62.0 °C.
- D** It has a volume of 0.52 cm<sup>3</sup>.
- E** It is shiny.

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-  It is shiny.

# Physical and Chemical Properties

- **PHYSICAL  
PROPERTY**

a property that a substance displays without changing its composition.

– *Odor, taste, color, appearance, melting point, boiling point, and density*

- **CHEMICAL  
PROPERTY**

a property that a substance displays only by changing its composition via a chemical change/rxn

– *Corrosiveness, acidity, and toxicity.*

**All of the following are examples of physical properties EXCEPT:**



**Density**



**Hardness**



**Melting Point**



**Combustible**



**Luster**

All of the following are examples of physical properties EXCEPT:



Density



Hardness



Melting Point



***Combustible***



Luster

# Which of the following is a chemical property?

-  You can squeeze oranges to make orange juice
-  Butter can be melted for popcorn
-  Sand can be separated from gravel
-  Hydrogen peroxide decompose into water and oxygen
-  Ozone is a gas at room temperature

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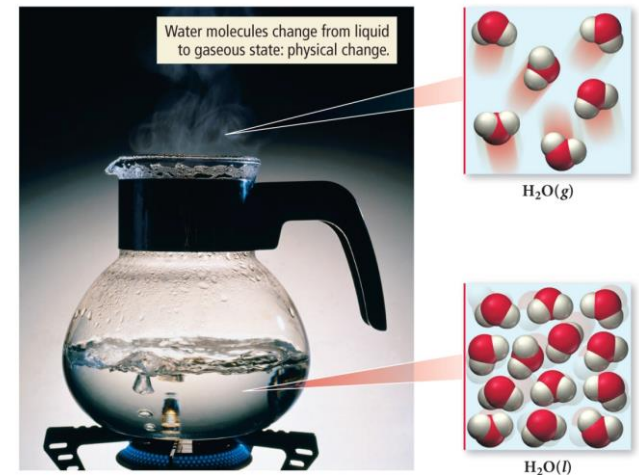
# **Types of Changes**

*Physical Change*

*Chemical Change*

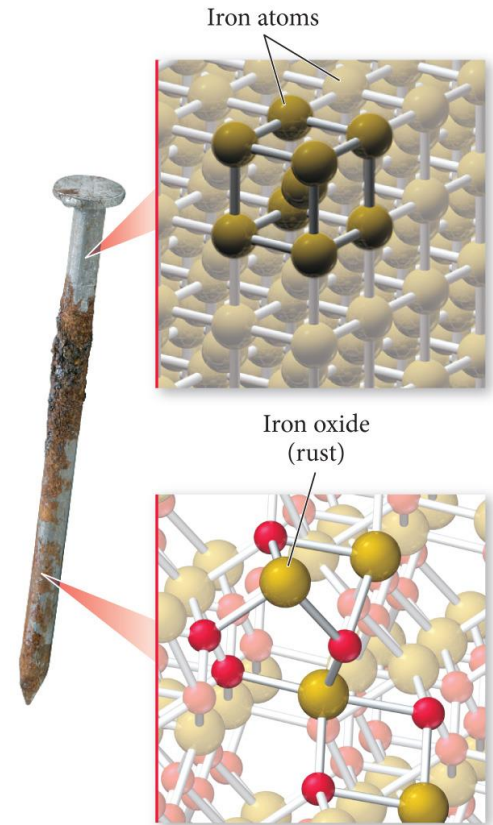
# Physical Change

- Changes only the state or appearance, but not composition
- The atoms or molecules do not change their identity during a physical change.
- **EXAMPLE:** Boiling water



# Chemical Change

- Changes the composition/identity of the substance
- Atoms rearrange, transforming the original substances into different substances.
- **EXAMPLE:** Iron rusting.  
Started as Fe and then it bonds with oxygen to make FeO.



# The Classification of Matter

- **Matter** is anything that occupies space and has mass.
- We can classify matter according to:
  - **state** (solid, liquid, gas)
  - **composition** (the basic components its made of).

# Classification of Matter by Components

- The first division in the classification of matter is between a *pure substance* and a *mixture*.
- **Pure substance** is made up of only one component and its composition is invariant.
- **Mixture**, by contrast, is a substance composed of two or more components in proportions that can vary from one sample to another.

# Classification of Pure Substances

- **Element**: a substance that cannot be chemically broken down into simpler substances.
  - Basic building blocks of matter
  - Composed of single type of atom, like helium
- **Molecule** is a substance composed of two or more atoms, but can be the same element –  $\text{H}_2$ ,  $\text{Br}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{CO}_2$
- **Compound** is a substance composed of two or more types of elements.  $\text{H}_2\text{O}$ ,  $\text{CO}_2$

- **Careful!**

- |               |               |
|---------------|---------------|
| $\text{H}_2$  | <i>Horses</i> |
| $\text{N}_2$  | <i>Need</i>   |
| $\text{O}_2$  | <i>Oats</i>   |
| $\text{F}_2$  | <i>For</i>    |
| $\text{Cl}_2$ | <i>Clear</i>  |
| $\text{Br}_2$ | <i>Brown</i>  |
| $\text{I}_2$  | <i>“Eyes”</i> |

| PERIODIC TABLE OF ELEMENTS    |                              |                                 |                                   |                               |                                |                               |                               |                                |                                  |                                 |                                 |                                 |                               |                                |                                 |                                |                               |
|-------------------------------|------------------------------|---------------------------------|-----------------------------------|-------------------------------|--------------------------------|-------------------------------|-------------------------------|--------------------------------|----------------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------------------|--------------------------------|---------------------------------|--------------------------------|-------------------------------|
| 1<br><b>H</b><br>Hydrogen     |                              |                                 |                                   |                               |                                |                               |                               |                                |                                  |                                 |                                 |                                 |                               |                                |                                 |                                | 2<br><b>He</b><br>Helium      |
| 3<br><b>Li</b><br>Lithium     | 4<br><b>Be</b><br>Beryllium  |                                 |                                   |                               |                                |                               |                               |                                |                                  |                                 |                                 | 5<br><b>B</b><br>Boron          | 6<br><b>C</b><br>Carbon       | 7<br><b>N</b><br>Nitrogen      | 8<br><b>O</b><br>Oxygen         | 9<br><b>F</b><br>Fluorine      | 10<br><b>Ne</b><br>Neon       |
| 11<br><b>Na</b><br>Sodium     | 12<br><b>Mg</b><br>Magnesium |                                 |                                   |                               |                                |                               |                               |                                |                                  |                                 |                                 | 13<br><b>Al</b><br>Aluminum     | 14<br><b>Si</b><br>Silicon    | 15<br><b>P</b><br>Phosphorus   | 16<br><b>S</b><br>Sulfur        | 17<br><b>Cl</b><br>Chlorine    | 18<br><b>Ar</b><br>Argon      |
| 19<br><b>K</b><br>Potassium   | 20<br><b>Ca</b><br>Calcium   | 21<br><b>Sc</b><br>Scandium     | 22<br><b>Ti</b><br>Titanium       | 23<br><b>V</b><br>Vanadium    | 24<br><b>Cr</b><br>Chromium    | 25<br><b>Mn</b><br>Manganese  | 26<br><b>Fe</b><br>Iron       | 27<br><b>Co</b><br>Cobalt      | 28<br><b>Ni</b><br>Nickel        | 29<br><b>Cu</b><br>Copper       | 30<br><b>Zn</b><br>Zinc         | 31<br><b>Ga</b><br>Gallium      | 32<br><b>Ge</b><br>Germanium  | 33<br><b>As</b><br>Arsenic     | 34<br><b>Se</b><br>Selenium     | 35<br><b>Br</b><br>Bromine     | 36<br><b>Kr</b><br>Krypton    |
| 37<br><b>Rb</b><br>Rubidium   | 38<br><b>Sr</b><br>Strontium | 39<br><b>Y</b><br>Yttrium       | 40<br><b>Zr</b><br>Zirconium      | 41<br><b>Nb</b><br>Niobium    | 42<br><b>Mo</b><br>Molybdenum  | 43<br><b>Tc</b><br>Technetium | 44<br><b>Ru</b><br>Ruthenium  | 45<br><b>Rh</b><br>Rhodium     | 46<br><b>Pd</b><br>Palladium     | 47<br><b>Ag</b><br>Silver       | 48<br><b>Cd</b><br>Cadmium      | 49<br><b>In</b><br>Indium       | 50<br><b>Sn</b><br>Tin        | 51<br><b>Sb</b><br>Antimony    | 52<br><b>Te</b><br>Tellurium    | 53<br><b>I</b><br>Iodine       | 54<br><b>Xe</b><br>Xenon      |
| 55<br><b>Cs</b><br>Cesium     | 56<br><b>Ba</b><br>Barium    | 57<br><b>La*</b><br>Lanthanum   | 72<br><b>Hf</b><br>Hafnium        | 73<br><b>Ta</b><br>Tantalum   | 74<br><b>W</b><br>Tungsten     | 75<br><b>Re</b><br>Rhenium    | 76<br><b>Os</b><br>Osmium     | 77<br><b>Ir</b><br>Iridium     | 78<br><b>Pt</b><br>Platinum      | 79<br><b>Au</b><br>Gold         | 80<br><b>Hg</b><br>Mercury      | 81<br><b>Tl</b><br>Thallium     | 82<br><b>Pb</b><br>Lead       | 83<br><b>Bi</b><br>Bismuth     | 84<br><b>Po</b><br>Polonium     | 85<br><b>At</b><br>Astatine    | 86<br><b>Rn</b><br>Radon      |
| 87<br><b>Fr</b><br>Francium   | 88<br><b>Ra</b><br>Radium    | 89<br><b>Ac**</b><br>Actinium   | 104<br><b>Rf</b><br>Rutherfordium | 105<br><b>Db</b><br>Dubnium   | 106<br><b>Sg</b><br>Seaborgium | 107<br><b>Bh</b><br>Bohrium   | 108<br><b>Hs</b><br>Hassium   | 109<br><b>Mt</b><br>Meitnerium | 110<br><b>Ds</b><br>Darmstadtium | 111<br><b>Rg</b><br>Roentgenium | 112<br><b>Cn</b><br>Copernicium | 113<br><b>Nh</b><br>Nihonium    | 114<br><b>Fl</b><br>Flerovium | 115<br><b>Mc</b><br>Moscovium  | 116<br><b>Lv</b><br>Livermorium | 117<br><b>Ts</b><br>Tennessine | 118<br><b>Og</b><br>Oganesson |
|                               |                              |                                 |                                   |                               |                                |                               |                               |                                |                                  |                                 |                                 |                                 |                               |                                |                                 |                                |                               |
| * 58<br><b>Ce</b><br>Cerium   |                              | 59<br><b>Pr</b><br>Praseodymium | 60<br><b>Nd</b><br>Neodymium      | 61<br><b>Pm</b><br>Promethium | 62<br><b>Sm</b><br>Samarium    | 63<br><b>Eu</b><br>Europium   | 64<br><b>Gd</b><br>Gadolinium | 65<br><b>Tb</b><br>Terbium     | 66<br><b>Dy</b><br>Dysprosium    | 67<br><b>Ho</b><br>Holmium      | 68<br><b>Er</b><br>Erbium       | 69<br><b>Tm</b><br>Thulium      | 70<br><b>Yb</b><br>Ytterbium  | 71<br><b>Lu</b><br>Lutetium    |                                 |                                |                               |
| ** 90<br><b>Th</b><br>Thorium |                              | 91<br><b>Pa</b><br>Protactinium | 92<br><b>U</b><br>Uranium         | 93<br><b>Np</b><br>Neptunium  | 94<br><b>Pu</b><br>Plutonium   | 95<br><b>Am</b><br>Americium  | 96<br><b>Cm</b><br>Curium     | 97<br><b>Bk</b><br>Berkelium   | 98<br><b>Cf</b><br>Californium   | 99<br><b>Es</b><br>Einsteinium  | 100<br><b>Fm</b><br>Fermium     | 101<br><b>Md</b><br>Mendelevium | 102<br><b>No</b><br>Nobelium  | 103<br><b>Lr</b><br>Lawrencium |                                 |                                |                               |

# Classification of Mixtures

- **Heterogeneous**: composition varies from one region of the mixture to another.
  - Chicken noodle soup, oil and vinegar
- **Homogeneous mixtures**: uniform compositions because the atoms or molecules that compose them mix uniformly.
  - Salt water, air

# Which of the following is a heterogeneous mixture?

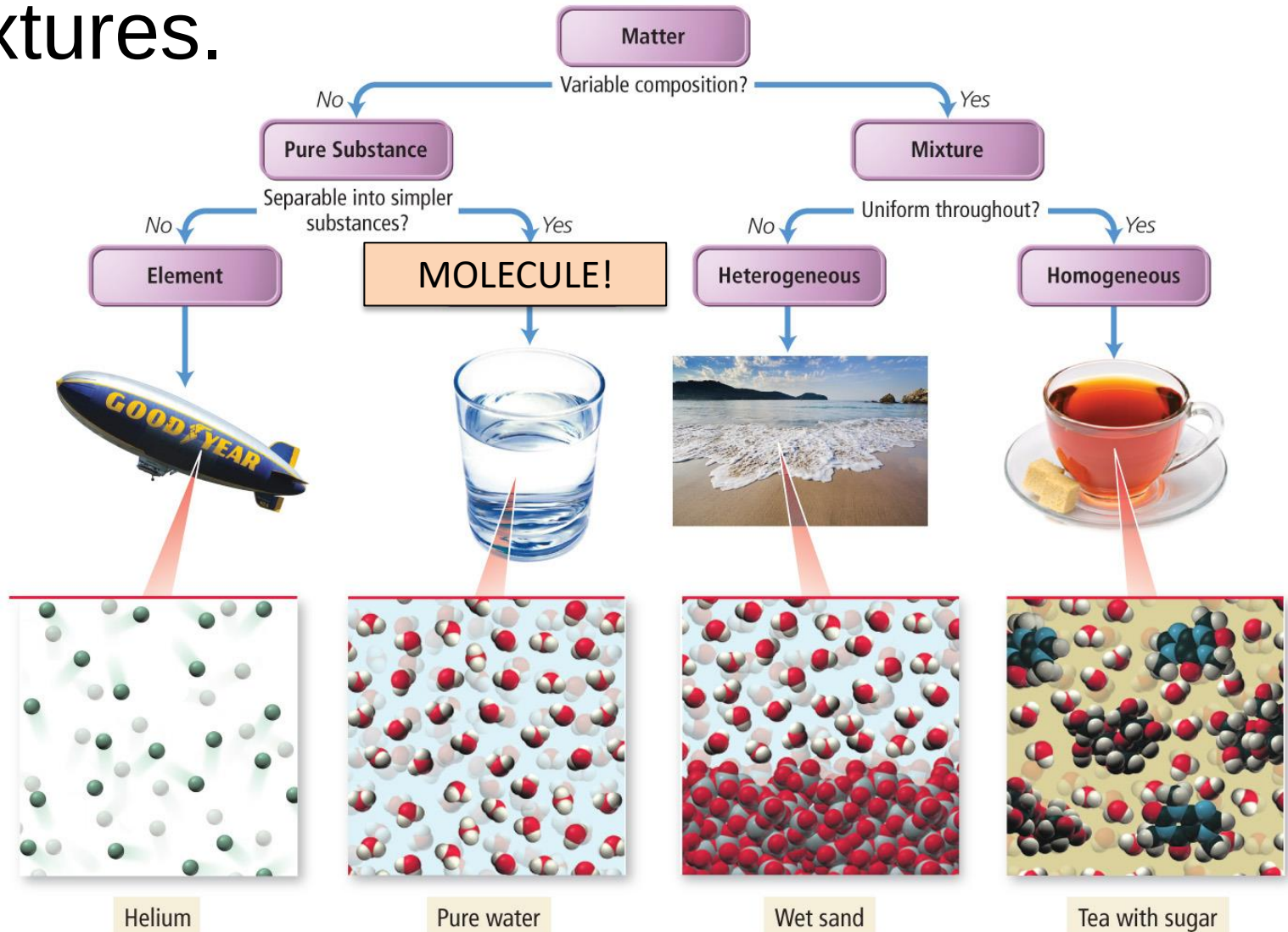
-  **A** Kool-aid
-  **B** Coffee
-  **C** A latte
-  **D** Hydrogen peroxide
-  **E** Ice

# Which of the following is a heterogeneous mixture?

-  A Kool-aid
-  B Coffee
-  C *A latte*
-  D Hydrogen peroxide
-  E Ice

# The Classification of Matter by Components

- Elements, compounds, and types of mixtures.

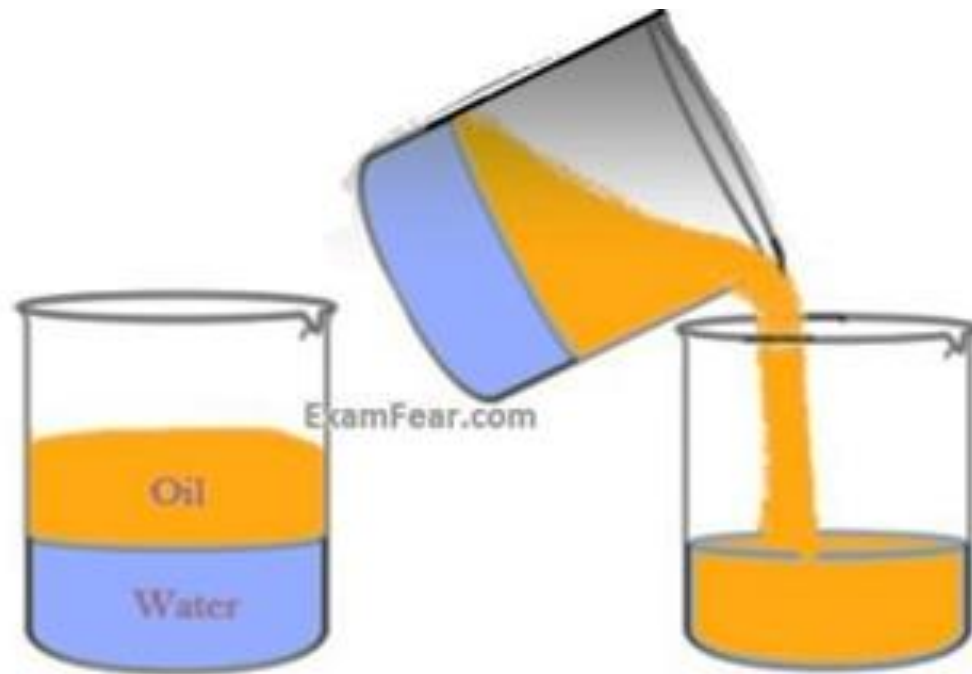


# **Separating Mixtures**

- Are separable because the different components have different physical or chemical properties.
- Various techniques that exploit these differences are used to achieve separation.

# Separating Mixtures

- A mixture of sand and water, or oil and water, can be separated by **decanting**—carefully pouring off the water into another container.

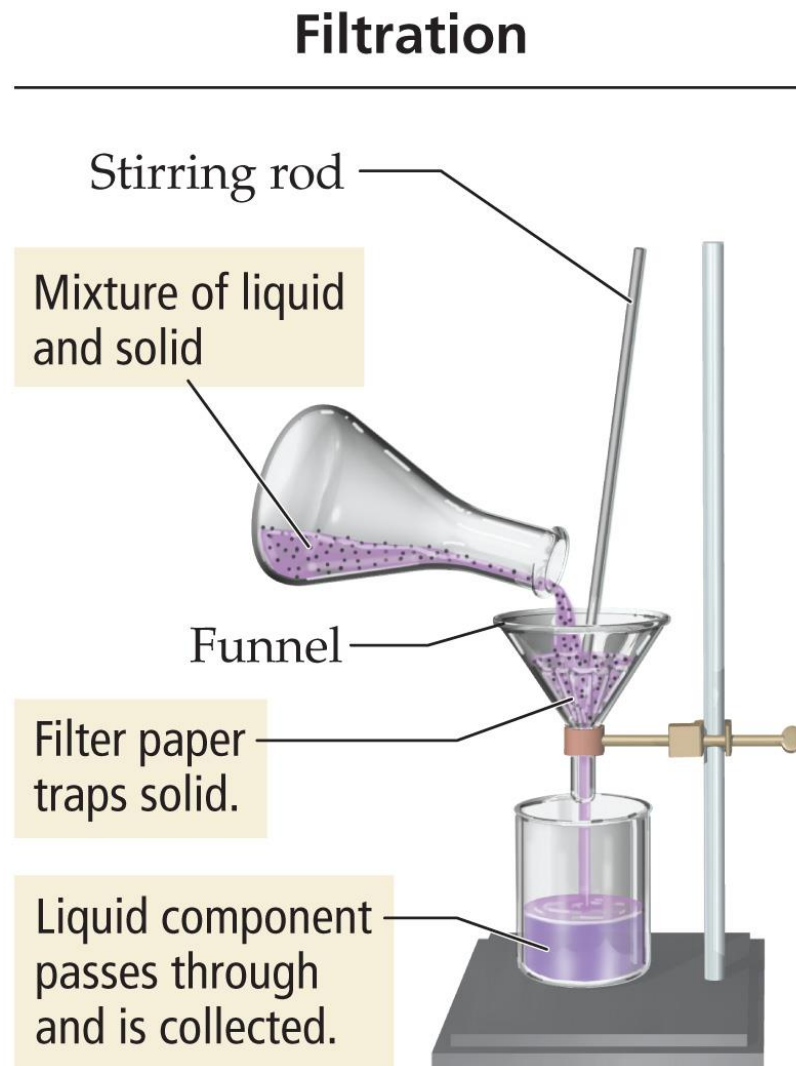


Mixture of oil and water.

Oil is separated from water

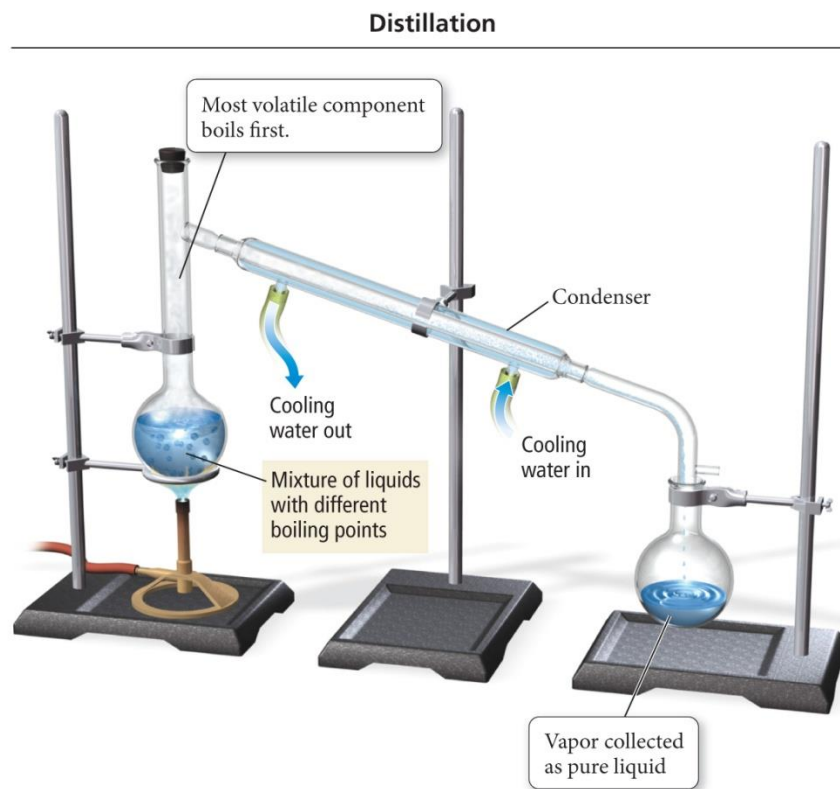
# Separating Mixtures

- A mixture of an insoluble solid and a liquid can be separated by **filtration**—process in which the mixture is poured through filter paper in a funnel.

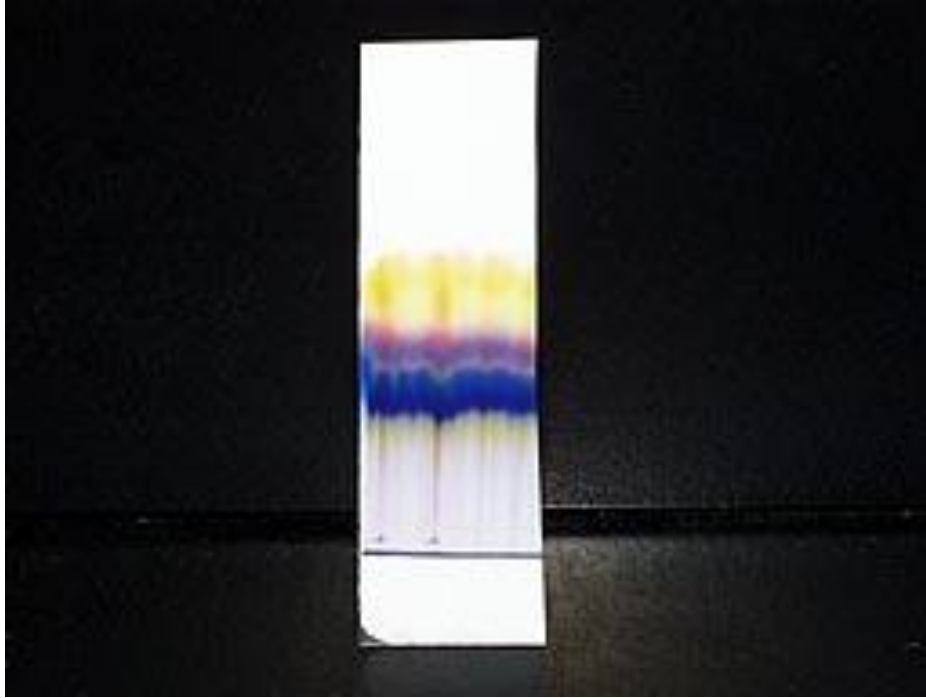


# Separating Mixtures

- A homogeneous mixture of liquids can usually be separated by **distillation**,
- Mixture is heated to boil off the more **volatile** (easily vaporizable) liquid.
- The volatile liquid is then re-condensed in a condenser and collected in a separate flask.



# Separation of a Mixture



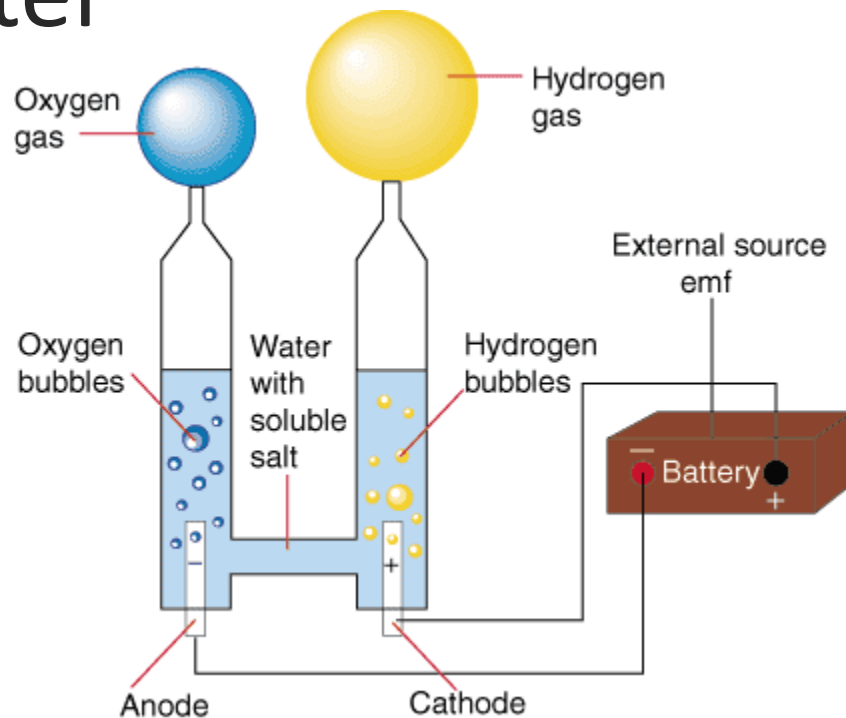
- The components of dyes such as ink may be separated by paper chromatography
- Some elements can travel further up the paper than others

# Separation of a Molecule/Compound

## The Electrolysis of water

Compounds must be separated by **chemical means**.

With the application of electricity, water can be separated into its elements



Reactant → Products

Water → Hydrogen + Oxygen

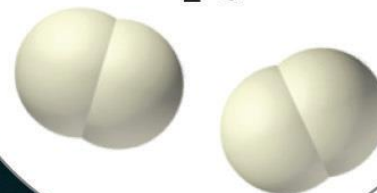


Product:  
element

Gaseous oxygen  
 $\text{O}_2(\text{g})$

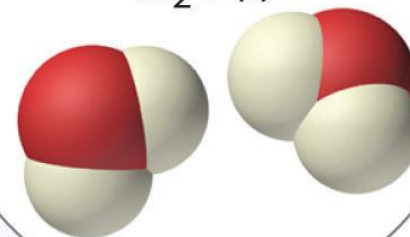


Gaseous hydrogen  
 $\text{H}_2(\text{g})$

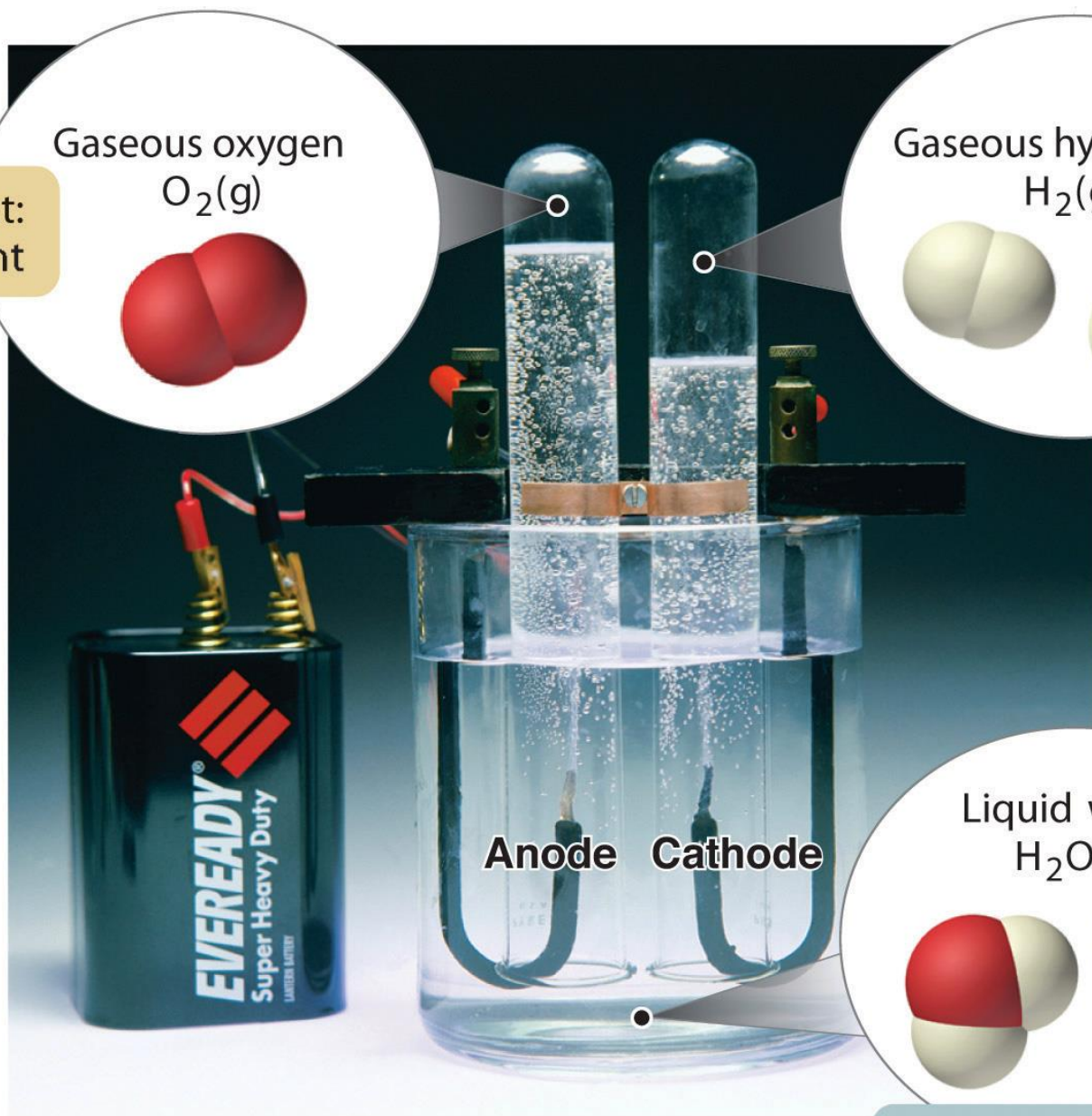


Product:  
element

Liquid water  
 $\text{H}_2\text{O}(\text{l})$



Reactant compound



# Extra Help about molecules vs. compounds using the "Rectangle versus square" analogy



4 sides  
4  $90^\circ$   
generic



molecule



2+ atoms  
bonded



more specific

4 sides  $\Rightarrow$  must be equal  
4  $90^\circ$



compound

2+ atoms  
bonded



must be  
different  
atoms



**Link to YouTube Video of Presentation:**

**[https://youtu.be/gQ64-kFWW\\_Q](https://youtu.be/gQ64-kFWW_Q)**