1. Matter, Pure Substances, Mixtures, and Particle Models

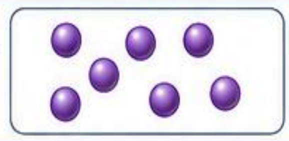
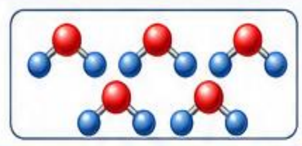
Everything in this section is easiest to understand by asking:
What kinds of particles are present, and are they chemically bonded or only physically mixed?

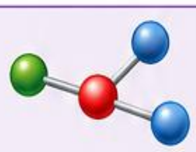
Matter and Its Classification

Matter can be classified as a pure substance or a mixture. A pure substance has a uniform and definite chemical composition, while a mixture contains substances combined physically rather than chemically.

Category	Meaning	Particle Clue
Pure substance	Uniform, definite chemical composition	Only one kind of particle throughout
Mixture	Substances physically combined	More than one kind of particle is present

Pure Substances: Elements and Compounds

Type	Definition	Particle Model
Element	Simplest substance; contains only one kind of atom	Identical atoms, or groups made only from the same kind of atom 
Compound	Two or more different elements chemically combined	Identical particles made of different kinds of atoms bonded together 



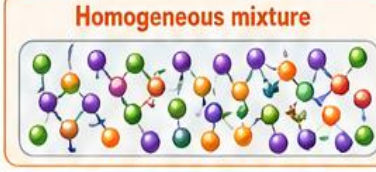
BALL-AND-STICK MODEL

In the class model, a **ball** represents a particle/atom and a **stick** represents a chemical bond. When different colored balls are connected in the same repeating pattern, the model can represent a compound.

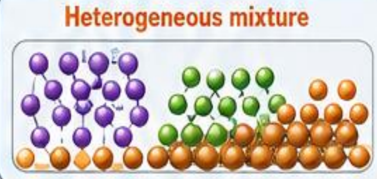
Mixtures: Homogeneous and Heterogeneous

Type	Composition	Observation
Homogeneous mixture	Uniform throughout	Components are evenly distributed; a solution belongs here
Heterogeneous mixture	Non-uniform	Different components or phases can be distinguished

Homogeneous mixture



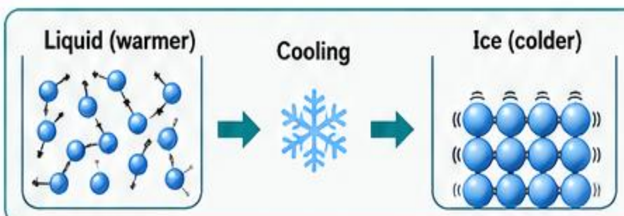
Heterogeneous mixture



Particle diagrams can also show a **mixture of elements**, **a mixture of compounds**, **or a mixture of elements and compounds**. The key clue is that more than one kind of particle appears in the same sample.

Particle Motion During Cooling and Freezing

The examples connect matter with particle motion. When a liquid is cooled and turns into ice, the particles move **more slowly and come closer together** in the Grade 7 particle model used in the course. They do not stop moving completely.



MASTERY CHECK

- ☐ I can tell an element, compound, and mixture apart from a particle diagram.
- ☐ I can explain the difference between homogeneous and heterogeneous mixtures.
- ☐ I can describe what happens to particle motion when matter cools or freezes.

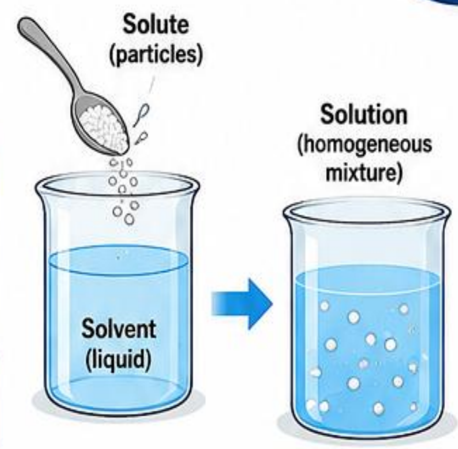
2. Solutions: Components and Basic Classification

1 What Is a Solution?

A **solution** is a homogeneous mixture. It has a uniform composition, and its two main components are the **solute and the solvent.**

Component	Role	Typical Amount in Class Examples
Solute	The substance being dissolved	Usually the smaller amount
Solvent	The substance that does the dissolving	Usually the greater amount

MEMORY RULE
Solute = gets dissolved. Solvent = does the dissolving.
Example: in salt water, salt is the solute and water is the solvent.



2 Soluble and Insoluble

Soluble means a substance can dissolve in a particular solvent. Insoluble means it does not dissolve in that solvent. The course examples include sugar, salt, powdered juice, and coffee as soluble in water, while sand, oil, and stones are treated as insoluble in water.

Always think of a solute-solvent pair. A substance may behave differently in a different solvent.

3 Aqueous and Non-Aqueous Solutions

Classification	Meaning	How to Decide
Aqueous	Water is the solvent	Ask: Is water doing the dissolving?
Non-aqueous	Water is not the solvent	The solvent is some other substance

DO NOT MIX UP CLASSIFICATIONS
A solution can be aqueous and liquid at the same time. "Aqueous" tells you what the solvent is. "Liquid solution" tells you the phase of the solvent.

4 Types of Solutions According to the Phase of the Solvent

This classification follows the phase of the solvent, not the phase of the solute.

Solution Type	Solvent Phase	Possible Solute Phases	Examples from Class
Gas solution	Gas	Gas	Air
Liquid solution	Liquid	Solid, liquid, or gas	Salt solution; sugar solution; vinegar; rubbing alcohol; carbonated drinks
Solid solution	Solid	Solid, liquid, or gas	Brass (zinc in copper); amalgam; gas dissolved in metal

COMMON TRAP
A solid solute dissolved in water is not automatically a solid solution.
If the solvent is liquid water, it is a liquid solution according to solvent phase.

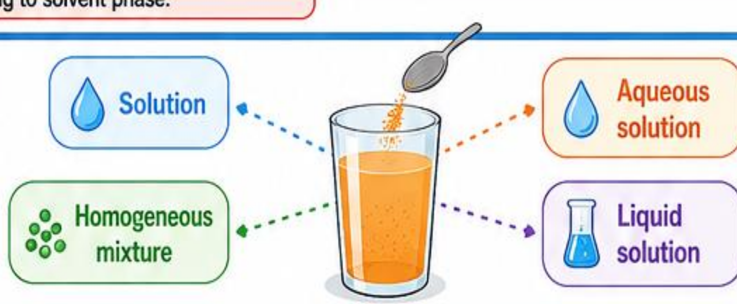
GAS SOLUTION (Solvent: Gas)
Example: Air

LIQUID SOLUTION (Solvent: Liquid)
Examples: Salt solution; carbonated drinks

SOLID SOLUTION (Solvent: Solid)
Examples: Brass; amalgam

5 One Mixture, Several Correct Labels

A powdered drink dissolved completely in water can be described in several correct ways at once: it is a solution, a homogeneous mixture, an aqueous solution, and a liquid solution. The labels answer different classification questions.



MASTERY CHECK

- ☐ I can identify solute and solvent from a situation.
- ☐ I can decide whether a solution is aqueous or non-aqueous.
- ☐ I can classify a solution as gas, liquid, or solid using the solvent phase.

3. Saturation, Solubility, and Factors Affecting Dissolving

GRADE 7 SCIENCE

Solubility

Solubility is the maximum amount of solute that can dissolve in a given amount of solvent under specific conditions. It tells how much of a substance can dissolve.

Types of Solutions According to Degree of Saturation

Type	What It Means	What Happens If More Solute Is Added?
Unsaturated	Below the maximum amount that can dissolve	More solute can still dissolve
Saturated	Maximum amount has dissolved under the conditions	Extra solute no longer dissolves completely and may remain at the **bottom**
Supersaturated	Contains more dissolved solute than a saturated solution normally holds	Unstable; excess solute may crystallize out when disturbed or conditions change

COMPARE AS A SET

Unsaturated = can dissolve more. Saturated = maximum reached. Supersaturated = holding more than normal and unstable.

Factors That Affect the Speed of Dissolving

Factor	Effect in the Class Activities	Particle-Level Explanation
Temperature	Hotter conditions usually made the solid dissolve faster	Particles have more energy, move faster, and collide more often
Stirring	Stirred samples dissolved faster	Movement increases contact and collisions between solute and solvent particles
Particle size	Powdered/crushed solute dissolved faster than large pieces	Smaller pieces provide greater total surface area exposed to the solvent

Temperature and Particle Motion

In the class hot-vs.-cold activities, warmer particles are described as having **higher energy**, moving more **rapidly**, and **colliding more often**. This explains why sugar, coffee, and similar solids in the examples generally dissolve faster in hot water than in cold water.

Stirring and Contact

Stirring does not change a solute into a different substance. It keeps particles moving and brings fresh solvent into contact with the solute surface, increasing the number of contacts and collisions.

Particle Size and Surface Area

A sugar cube and powdered sugar can have the same material, but the powder has **much more surface area exposed** to water. More exposed surface gives more places for solvent particles to contact the solute at the same time.

Saturation Is Not the Same as Concentration

Concentrated   Dilute

A **concentrated** solution has a relatively large amount of solute, while a **dilute** solution has relatively little solute. Saturation asks a different question: has the maximum dissolving limit been reached? A solution can be concentrated and still unsaturated if more solute can dissolve.

CAUSE-AND-EFFECT SHORTCUT

[ ] Independent = what I change.
Dependent = what I measure.
Controlled = what I keep the same.

Variables in a Dissolving Investigation

Variable Type	Meaning	Example: Temperature vs. Dissolving Time
Independent variable	The factor deliberately changed	Water temperature
Dependent variable	The result measured or observed	Time needed for sugar to dissolve
Controlled variables	Factors kept the same for a fair test	Amount of sugar; volume of water; type of container; stirring condition

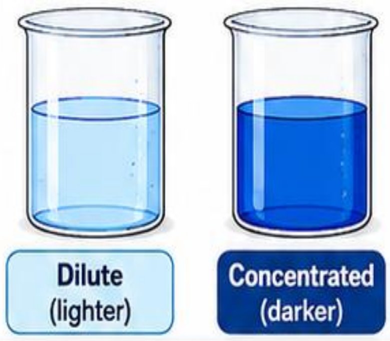
MASTERY CHECK

- [ ] I can compare unsaturated, saturated, and supersaturated solutions.
- [ ] I can explain temperature, stirring, and particle size using particles and collisions.
- [ ] I can identify independent, dependent, and controlled variables in a

4. Concentration: Dilute, Concentrated, Percent by Mass, and Percent by Volume

1 Dilute and Concentrated Solutions

Term	Meaning	Typical Visual Example
Dilute / diluted	Relatively small amount of dissolved solute	A colored solution may appear lighter
Concentrated	Relatively large amount of dissolved solute	A colored solution may appear darker



2 Percent by Mass

FORMULA

Percent by mass = (mass of solute / mass of solution) × 100

Use mass units such as grams (g).

The denominator is the **mass of the solution**, not simply the mass of the solvent.

THE IMPORTANT TRAP

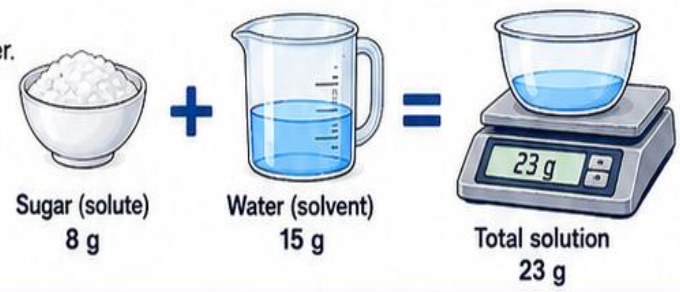
If the problem gives the mass of solute and the mass of water/solvent,
first find the total solution: mass of solution = mass of solute + mass of solvent.

Worked Example: Percent by Mass

A sugar solution contains 8 g of sugar dissolved in 15 g of water.

1. **Find total mass of solution: 8 g + 15 g = 23 g.**
2. **Substitute: (8 g / 23 g) × 100.**
3. **Calculate: 34.78%** (approximately).

Notice why dividing by 15 g would be wrong: 15 g is only the solvent, not the complete solution.



3 Percent by Volume

FORMULA

Percent by volume = (volume of solute / volume of solution) × 100

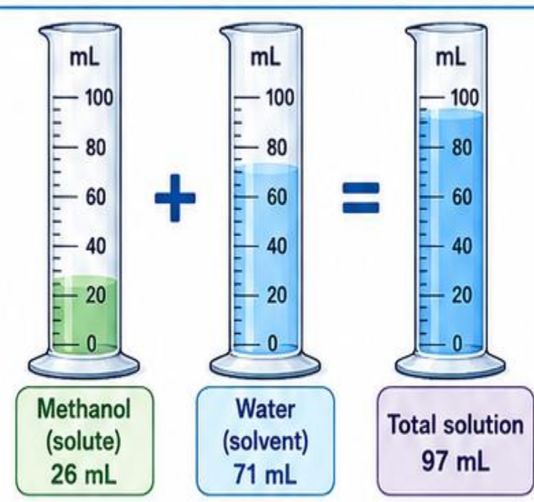
Use volume units such as milliliters (mL).

For the class-style problems, if the solute volume and solvent volume are listed separately, first find the total solution volume by adding them.

Worked Example: Percent by Volume

A mixture contains 26 mL of methanol and 71 mL of water.

1. **Find total volume: 26 mL + 71 mL = 97 mL.**
2. **Substitute:** (26 mL / 97 mL) × 100.
3. **Calculate: 26.80%** (approximately).



4 Choosing the Correct Method

Clue in the Problem	Method
Mass, grams, solid solute measured by mass	Percent by mass
Volume, mL, liquid solute measured by volume	Percent by volume

5 BEFORE CALCULATING

Ask two questions:

(1) What is the solute?

(2) Did the problem already give the total solution, or only the solute and solvent separately?

6 MASTERY CHECK

- [ ] I can explain dilute vs. concentrated without confusing them with saturation.
- [ ] I can calculate percent by mass and percent by volume.
- [ ] I remember to use total solution in the denominator.

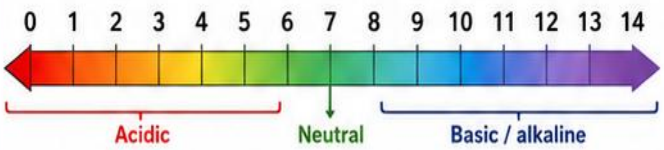
5. Acids, Bases, Neutral Substances, pH, and Indicators

1 The pH Scale

Category	pH	Main Idea
Acid	Below 7	Acidic
Neutral	Exactly 7	Neither acidic nor basic
Base / alkaline	Above 7	Basic / alkaline

CORE pH RULE

pH < 7 = acid. pH = 7 = neutral. pH > 7 = base.



2 Properties of Acids, Bases, and Neutral Substances

Property	Acid	Neutral	Base
pH	Below 7	7	Above 7
Taste described in lessons	Sour	Neither	Bitter
Touch / material effect	May be corrosive	Neither	Often slippery
Blue litmus	Turns red	No change	Stays blue
Red litmus	Stays red	No change	Turns blue

LITMUS MEMORY

Blue -> Red = Acid. Red -> Blue = Base.
Neutral = no color change.

3 Indicators: Litmus vs. Universal pH Paper

Indicator	What It Tells You	How It Is Used in the Lessons
Litmus paper	Whether a sample behaves as an acid or base	Watch for blue-to-red or red-to-blue color change
Universal pH paper	A pH value or range from the color scale	Dip briefly, then compare the resulting color with the scale

4 Examples from the Acid/Base Activities

Sample	Approximate pH in Class Activity	Classification
Calamansi juice	2–3	Acidic
Vinegar	3–4	Acidic
70% isopropyl alcohol	7	Neutral
Baking soda + water	8–9	Basic
Bleach	11–13	Basic

5 Everyday pH Context

The everyday-life lesson applies pH to the body, hair care, rain, swimming pools, and seawater. The key skill is not to memorize every pictured number. Instead, use the pH value to decide whether the sample is acidic, neutral, or basic, then connect that classification to its properties.

- Stomach contents are strongly acidic in the lesson example.
- Hair is shown as naturally slightly acidic.
- Normal rain is mildly acidic; acid rain is more acidic.
- Swimming-pool water is shown slightly above neutral in the example.
- Seawater is shown as slightly basic.

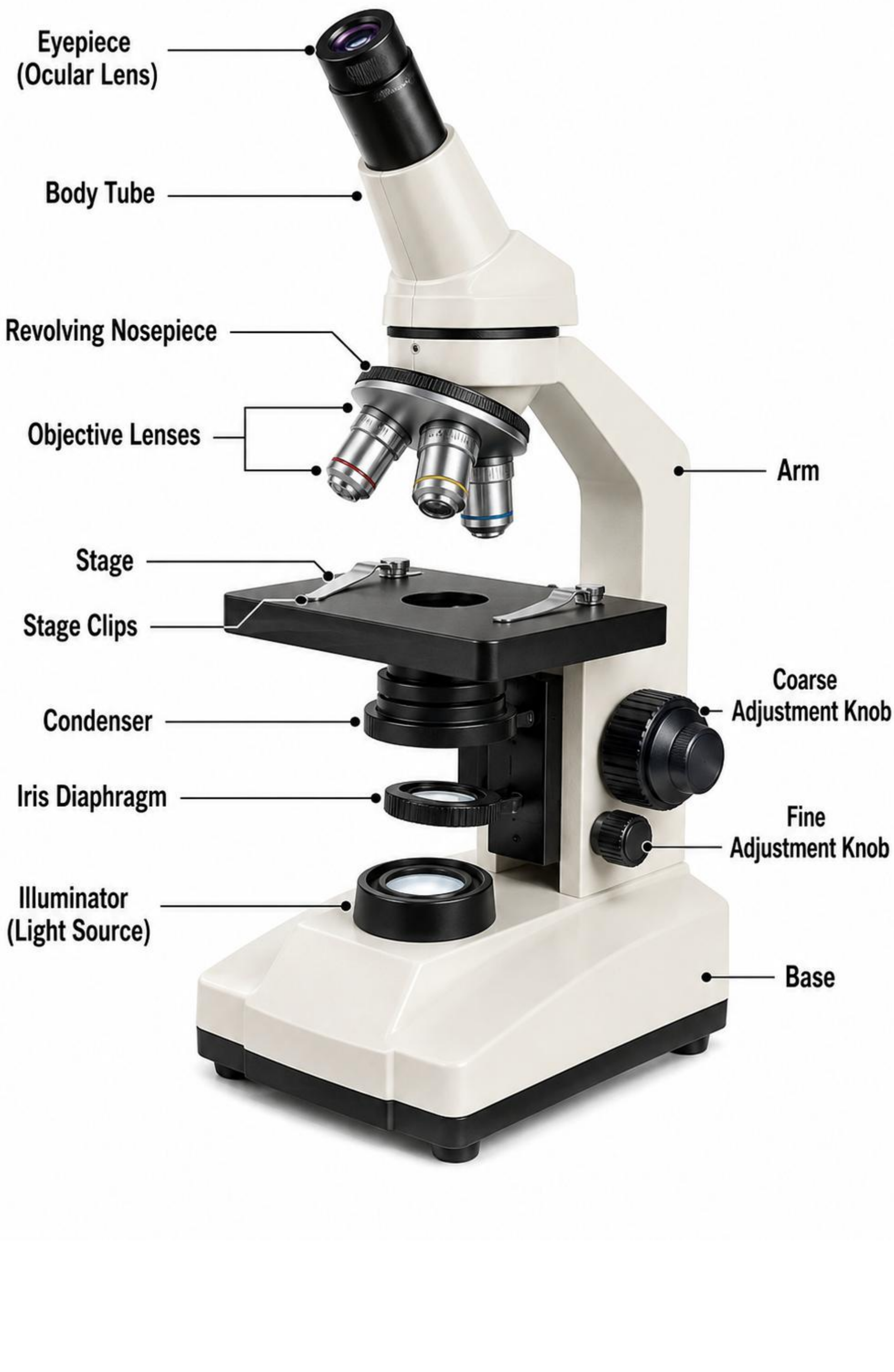
6 Uses Mentioned in the Lessons

Acids are connected with food ingredients, digestion/stomach acid, manufacturing, and laboratory chemicals. Bases are connected with soaps, cleaning agents, and manufacturing. These applications help explain why acids and bases matter outside the classroom.

7 MASTERY CHECK

[ ] I can classify any pH value as acidic, neutral, or basic.
[ ] I can predict the correct litmus-paper change.
[ ] I can explain the difference between litmus and universal pH paper.

Compound Light Microscope



6. The Compound Microscope: Parts, Functions, Magnification, Care, and Storage

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1. Main Parts and Functions

Part	Function
Eyepiece / ocular lens	The lens you look through; usually 10x
Body tube	Connects the eyepiece to the lower lenses and allows light to pass upward
Revolving nosepiece	Holds the objective lenses and rotates to change magnification
Scanning objective (4x)	Shortest objective; used first to find and center the specimen
Low-power objective (10x)	General viewing; wider field of view than high power
High-power objective (40x)	Used to see finer details; use fine adjustment for focusing
Stage	Flat platform where the slide is placed
Stage clips	Hold the slide in place
Diaphragm	Controls the amount of light passing through the specimen
Light source	Provides light so the specimen can be seen
Arm	Supports the upper parts; held when carrying correctly
Base	Supports the entire microscope and keeps it steady
Coarse adjustment knob	Provides rough focus, used on low power
Fine adjustment knob	Sharpens the image, especially on high power

2. Useful Part Groups

Group	Parts
Magnifying parts	Eyepiece and objective lenses
Changing magnification	Revolving nosepiece and objective lenses
Supporting parts	Arm and base
Slide/light parts	Stage, stage clips, diaphragm, light source
Focusing parts	Coarse and fine adjustment knobs

3. Total Magnification

FORMULA

Total magnification = eyepiece magnification x objective magnification

Eyepiece	Objective	Total Magnification
10x	4x scanning	40x
10x	10x low power	100x
10x	40x high power	400x

4. Correct Microscope Handling: Before Use

- Carry with two hands: one hand holds the arm while the other supports the base.
- Carry the microscope upright and carefully.
- Place it on a flat, stable table away from the edge.
- Do not drag or bump the microscope.

5. Correct Microscope Use

- Begin with the scanning or low-power objective.
- Find and center the specimen before moving to higher power.
- Use the **coarse adjustment knob** on low power for rough focus.
- Use the **fine adjustment knob** to sharpen the image, especially on high power.

HIGH-POWER SAFETY

Once you are on **high power**, use the fine **adjustment knob** rather than the coarse adjustment knob. This protects the slide and objective and gives safer, more precise focusing.

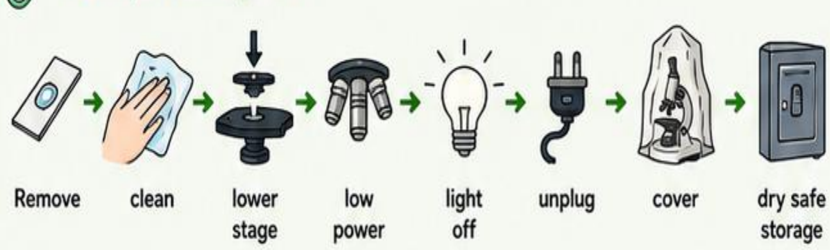
6. Cleaning After Use

- Remove the slide.
- Wipe or clean the stage.
- Clean lenses with **lens paper only**.
- Do not touch the lenses with your fingers.

7. Correct Storage Sequence

1. Remove the slide and clean the stage/lenses.
2. Lower the stage.
3. Return the microscope to low power.
4. Turn off the light.
5. Unplug carefully.
6. Cover the microscope.
7. Store it in a dry, safe place.

8. Complete Memory Chain



7. MEASUREMENT AND UNIT CONVERSION

GRADE 7 SCIENCE

1 WHAT IS UNIT CONVERSION?

Unit conversion changes the unit used to express a measurement without changing the actual physical quantity. For example, 3.5 m and 350 cm represent the same length.

2 FACTOR-LABEL METHOD / DIMENSIONAL ANALYSIS

1. Write the given measurement.
2. Multiply by a correct conversion factor.
3. Place the unwanted unit so it cancels.
4. Multiply or divide the numbers and write the remaining unit.

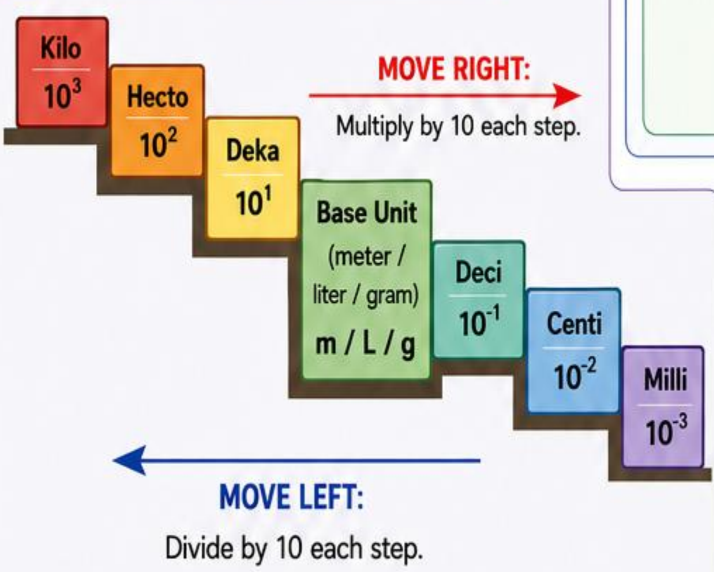
Example: 3.5 m to cm

DIMENSIONAL ANALYSIS

$$3.5\ \text{m} \times \left(\frac{100\ \text{cm}}{1\ \text{m}}\right) = 350\ \text{cm}$$

The meter unit cancels, leaving centimeters.

3 METRIC CONVERSION LADDER



4 IMPORTANT METRIC CONVERSIONS

Quantity	Conversion
Length	1 km = 1000 m
Length	1 m = 100 cm
Length	1 cm = 10 mm
Mass	1 kg = 1000 g
Mass	1 g = 1000 mg
Volume	1 L = 1000 mL

5 ENGLISH-SYSTEM CONVERSIONS IN THE HANDOUT

Measure	Conversion
Length	12 in = 1 ft; 3 ft = 1 yd; 5280 ft = 1 mi
Weight	16 oz = 1 lb
Capacity	2 pt = 1 qt; 4 qt = 1 gal

6 METRIC-ENGLISH CONVERSIONS FACTORS

Conversion
1 in = 2.54 cm
1 ft = 30.48 cm
1 mi = 1.609 km
1 kg = 2.205 lb
1 lb = 0.454 kg
1 gal = 3.7854 L

7 TIME CONVERSIONS

Conversion
60 s = 1 min
60 min = 1 h
24 h = 1 day
7 days = 1 week
12 months = 1 year
365 days = 1 year

8 TEMPERATURE SCALES AND FORMULAS

Conversion	Formula
Celsius to Fahrenheit	F = (C × 9/5) + 32
Fahrenheit to Celsius	C = (F − 32) × 5/9
Celsius to Kelvin	K = C + 273.15
Kelvin to Celsius	C = K − 273.15

KELVIN RULE

Kelvin is written with no degree symbol.
Correct: 300 K. Incorrect: 300 degrees K / 300°K.

9 COMMON CONVERSION MISTAKES

- Forgetting the unit in the final answer.
- Using the wrong conversion factor.
- Multiplying when division is needed, or dividing when multiplication is needed.
- Failing to cancel the unwanted unit.
- Using a degree symbol with Kelvin.

10 BEFORE YOU SOLVE

Check the given unit, the target unit, and choose the correct conversion factor before solving.

11 MASTERY CHECK

[ ] I can arrange conversion factors so unwanted units cancel.

[ ] I know the key length and temperature conversions used in the activity.

[ ] I remember that Kelvin uses no degree symbol.

Measure carefully. Convert correctly. Think like a scientist!

8. SCIENCE PROCESS SKILLS AND SCIENTIFIC INVESTIGATION

Think like a scientist. Ask questions. Find answers. Share what you learn!

1 SIX BASIC SCIENCE PROCESS SKILLS

SKILL	MEANING	EXAMPLE
Observing	Collecting information using the senses	Noticing color, smell, texture, sound, or a measured change
Measuring	Determining size, quantity, or extent using standard units/tools	Using a ruler or graduated cylinder
Inferring	Interpreting an observation using prior knowledge/ information	Yellow leaves may suggest a plant problem
Classifying	Grouping objects or events by similar characteristics	Sorting materials into groups
Predicting	Projecting an outcome from reliable observations and inferences	Dark clouds may lead to a prediction of rain
Communicating	Sharing scientific results	Statements, graphs, charts, diagrams, presentations

2 QUALITATIVE AND QUANTITATIVE DATA

DATA TYPE	MEANING	EXAMPLES
Qualitative	Descriptive information	Red, rough, sweet-smelling, cloudy
Quantitative	Numerical or measured information	8 cm, 27 C, 14 g, 6 leaves

QUICK MEMORY

Qualitative = quality/description. Quantitative = quantity/number.

5 RESULTS VS. CONCLUSION

SECTION	WHAT BELONGS HERE
Results	Recorded observations, measurements, data tables, graphs, and patterns
Conclusion	What the results mean; direct answer to the problem; whether evidence supports the hypothesis

3 THE SEVEN STEPS OF SCIENTIFIC INVESTIGATION

1. **Identification of the problem** - state a clear, specific, testable question.
2. **Formulation of hypothesis** - propose a testable tentative answer.
3. **Experimentation** - carry out a fair test.
4. **Collection of data** - record observations and measurements.
5. **Analysis of data** - look for patterns, comparisons, and trends.
6. **Generation of conclusion(s)** - answer the problem using the evidence.
7. **Communication of results** - share findings so others can understand and verify them.

HYPOTHESIS

A hypothesis is a **testable tentative answer** to the scientific problem.

A useful classroom pattern is: **If [independent variable changes], then [dependent variable will respond].**

The lesson also introduces a **null hypothesis** (the change will have no effect) and an **alternative hypothesis** (the change will have an effect).

4 EXPERIMENTAL VARIABLES

VARIABLE	MEANING	PLANT-GROWTH EXAMPLE
Independent	The factor deliberately changed	Amount of sunlight
Dependent	The result measured	Plant growth / height
Controlled	Factors kept the same	Plant type, soil, water, pot size, temperature

DO NOT CONFUSE THEM

Results = what happened. Conclusion = what it means.

Measurements and observations belong first in the **results** section.

MASTERY CHECK

- ☐ I can distinguish observation, inference, prediction, and measurement.
- ☐ I can tell qualitative data from quantitative data.
- ☐ I can identify investigation steps, variables, results, and conclusions.

Be curious. Be careful. Be honest. Be a scientist!

SCIENCE 7 – TERM I EXAMINATION

Review Pointers / Coverage to Review

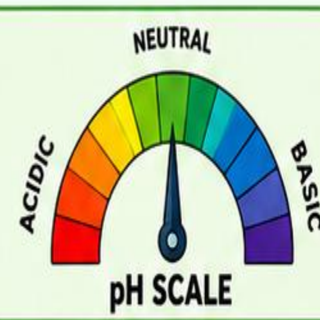
Please review the following topics for the TERM I examination.

1. SOLUTIONS

- Identify the role of the solute and solvent in a solution.
- Components of solution
- Types of solution based on:
  - phase of the solvent
  - if it is aqueous or not
- Express quantitatively the amount of solute present in a given volume of solvent.
- Percent concentration
  - diluted solution
  - concentrated solution
- Demonstrate how different factors affect the solubility of a solute in a given solvent, such as heat.
- Factors affecting solubility

2. ACIDS, BASES, AND SALTS

- Identify solutions found at home and in school that react with a litmus indicator as acids, bases, and salts.
- Acid, base, neutral substances



3. COMPOUND MICROSCOPE

- Identify the parts and functions of a compound microscope.
- Parts and functions of a compound microscope
- Demonstrate proper handling and storing of a compound microscope.
- Proper handling and storing of a compound microscope

4. TOPICS FROM ST1 AND ST2

- Describe the Particle Model of Matter as: "All matter is made up of tiny particles with each pure substance having its own kind of particles."
- Make accurate measurements using standard units for physical quantities and organize collected data when carrying out a scientific investigation. (focused on conversion)
- Follow appropriate steps of a scientific investigation, including aim/problem, materials and equipment, methods, results, and conclusion.