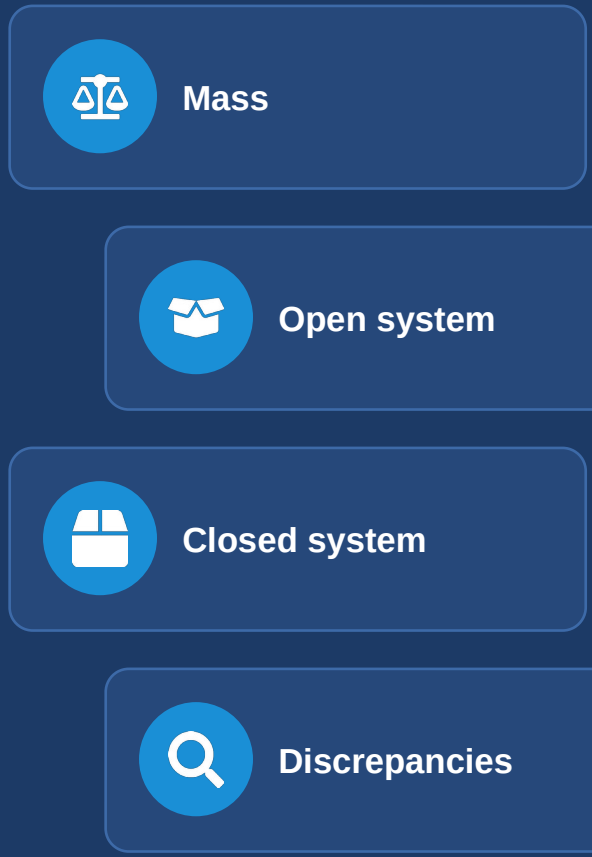
SNC2D Chemical Reactions, Lesson 6

Conservation of Mass Lab

Open and closed systems



Today's goals

We are learning…

- To test the law of conservation of mass.
- To explain differences between expected and measured results.

I can…

- Measure mass before and after a reaction accurately.
- Compare an open system with a closed system.
- Calculate a change in mass and a percent change.
- Account for discrepancies using evidence.

Today's plan

Time	What we're doing	You will…
0–10 min	**Hook**	Predict
10–20 min	**Plan**	Read the procedure
20–45 min	**Lab**	Measure and record
45–60 min	**Analyse**	Calculate
60–70 min	**Discrepancies**	Explain
70–75 min	**Exit**	Answer

Where does the mass go?

A log burns in a campfire and leaves a small pile of ash. Did the log's mass disappear? Where did it go?

Sentence starters

“I think the mass…”

“The atoms could have…”

“We could test this by…”

How it works

- Think for 1 minute.
- Pairs: agree on an answer and a test.



Big idea

In a chemical reaction, the total mass of the products equals the total mass of the reactants, because atoms are only rearranged. If mass seems to change, something entered or left the system, such as a gas.

Open and closed systems



Open system

- Matter can enter or leave.
- Example: a cup with no lid.
- A gas product can escape.
- Mass may seem to change.



Closed system

- Nothing can enter or leave.
- Example: a sealed bag.
- All products stay inside.
- Mass should stay the same.

Law of conservation of mass: mass of reactants = mass of products.

Procedure

Two trials. Same amounts each time: 2.0 g baking soda, 30 mL vinegar.

1. Open cup: mass the cup of vinegar and the paper of baking soda together.
2. Add the baking soda; wait until fizzing stops; mass everything again (including the paper).
3. Sealed bag: stand the cup of vinegar inside the bag; put the baking soda in a corner.
4. Press out the air, seal, and mass the bag.
5. Tip the cup inside the sealed bag. When fizzing stops, mass again.

Run the lab

In groups of three:

1. Zero (tare) the balance with nothing on it.
2. Record every mass to 0.01 g.
3. Record observations: bubbles, bag inflating, temperature by touch.
4. Clean up: liquids down the sink with water, bags in the garbage.

Sample class data

Trial	Before (g)	After (g)	Change (g)
Open cup	64.83	63.96	?
Sealed bag	71.52	71.38	?

Original sample data. Calculate the change and the percent change.

Model: change and percent change

Task: Calculate the change in mass and percent change for each trial.

Open cup: change = 63.96 g − 64.83 g = −0.87 g
Percent change = 0.87 g ÷ 64.83 g × 100% = 1.3%

Sealed bag: change = 71.38 g − 71.52 g = −0.14 g
Percent change = 0.14 g ÷ 71.52 g × 100% = 0.20%

The open cup lost about 6 times as much mass as the sealed bag.

Why it works

- Same method both rows.
- Units on every value.
- Sig digits match the data.
- Compares the two trials.

Why did the sealed bag lose a little?

Tiny leaks

Some gas escaped at the seal.

Buoyancy

The puffed-up bag pushes aside more air, so air pushes up on it a little more.

Balance precision

Readings are ±0.01 g; small changes are close to the limit.

Spills or drips

Liquid on the outside of the bag before the first reading.

Your turn: analysis

On page 2:

1. Calculate change and percent change for both trials.
2. Explain the open-cup result.
3. Give two reasons for the sealed-bag discrepancy.
4. Solve the copper problem and write its balanced equation.

Quick check

- State the law of conservation of mass.
- Why did the open cup lose mass?
- What is the difference between an open and a closed system?
- How does atomic theory explain conservation of mass?

Exit ticket

1. Your sealed-bag result and what it shows.

2. One discrepancy and its cause.

3. Why chemical equations must have the same atoms on both sides.

Next class: Balancing Equations.

Teacher reveal

Mass lab: worked answers

Open cup change: 63.96 g − 64.83 g = −0.87 g. Percent change: 0.87 ÷ 64.83 × 100% = 1.3%.

Sealed bag change: 71.38 g − 71.52 g = −0.14 g. Percent change: 0.14 ÷ 71.52 × 100% = 0.20%.

Interpretation: The open cup lost much more mass because carbon dioxide gas escaped into the air. The sealed bag kept almost all the products, so its mass stayed nearly the same: evidence for conservation of mass.

Discrepancy: The bag still lost 0.14 g: buoyancy of the inflated bag, a tiny leak at the seal, or balance uncertainty (±0.01 g). The change is small compared with the open cup.

Copper problem: 2.54 g of copper heated in air became 3.18 g of copper(II) oxide. Mass increased by 0.64 g because oxygen from the air (outside the system) joined the copper: $2Cu + O_2 \rightarrow 2CuO$.

Atomic theory: Atoms are rearranged, not created or destroyed, so the total mass of the atoms is the same before and after.