Chemical Changes

i. What is a Change?

In science, a change refers to the process of something becoming different. We can classify changes into two main types: Physical Changes and Chemical Changes. To understand chemical changes, it's important to first know what a physical change is.

Physical Change: A change in the form, size, shape, or state of a substance, but not its chemical identity. No new substance is formed.

Examples: Melting ice (solid water to liquid water), tearing paper, chopping wood, dissolving sugar in water.

What is a Chemical Change?

A chemical change is a process that results in the formation of one or more new substances with different chemical properties and a different composition from the original substances. These changes are often difficult or impossible to reverse.

In simple terms: The "ingredients" (called reactants) combine and rearrange their atoms to create something completely new (called products). A chemical change is also known as a chemical reaction.

Analogy: Think about baking a cake. You start with flour, eggs, sugar, and butter (reactants). After baking, you have a cake (product). You can't get the original flour, eggs, or sugar back. The cake is a new substance with its own properties (taste, texture, smell).

ii. Key Indicators of a Chemical Change

How can you tell a chemical change has happened?

Look for these signs:

- **Change in Colour:** An unexpected colour change. (e.g., iron turning reddish-brown when it rusts).
- **Production of a Gas:** Formation of bubbles or fizzing. (e.g., adding baking soda to vinegar).
- **Formation of a Precipitate:** When two liquids are mixed, a solid substance is formed. This solid is called a precipitate. (e.g., mixing milk and lemon juice causes milk solids to curdle and separate).
- Change in Energy (Heat, Light, Sound):

- **Exothermic Reaction:** The reaction releases energy, usually as heat or light. It feels warm. (e.g., burning wood).
- **Endothermic Reaction:** The reaction absorbs energy from its surroundings. It feels cold. (e.g., some instant cold packs).
- **Change in Smell or Taste:** A new odour is produced. (e.g., food spoiling, an egg rotting).

SAFETY NOTE: Never taste anything in a science lab to check for a chemical change!

iii. Important Terms

- **Reactants:** The original substances that you start with before the chemical reaction begins.
- **Products:** The new substances that are formed as a result of the chemical reaction.
- **Chemical Reaction:** The process in which reactants are transformed into products. We can write this as a simple word equation: Reactants → Products

iv. Detailed Examples with Explanations

Example	Reactants	Products	Signs of Chemical Change
Rusting of Iron	Iron, Oxygen (from air), Water (from moisture)	Iron Oxide (Rust)	Colour Change: Silvery iron becomes reddish-brown rust. - New Substance: Rust is flaky and weak, unlike strong iron.
Burning Wood	Wood, Oxygen	Ash, Carbon Dioxide, Water Vapour, Smoke	nergy Change: Produces heat and light. - Gas Production: Smoke and gases are released. - New Substance: Ash is a new substance that cannot be turned back into wood.
Digestion of Food	Complex food molecules (e.g., starches, proteins), Stomach Acid, Enzymes	Simpler molecules (e.g., sugars, amino acids)	New Substances: Food is broken down into new, simpler substances the body can absorb. - This is a complex series of chemical reactions.
Vinegar + Baking Soda	Acetic Acid (Vinegar), Sodium Bicarbonate (Baking Soda)	Carbon Dioxide gas, Sodium Acetate, Water	Gas Production: Intense bubbling and fizzing is observed. - Temperature Change: The mixture often feels slightly colder (endothermic).

v. Common Misconceptions and Clarifications

Misconception	Clarification
"Boiling water is a chemical change because bubbles form."	The bubbles are steam (gaseous water), not a new gas. The substance is still water (H_2O), just in a different state. This is a physical change (change of state).
"Dissolving salt in water is a chemical change because the salt disappears."	The salt has not disappeared. It has broken down into tiny particles and mixed with the water to form a solution. If you evaporate the water, you will get the salt back. This is a physical change.
"Any change in colour is a chemical change."	Not always. Mixing red and blue paint to get purple is a physical change. The red and blue pigments are just mixed, not chemically bonded. An *unexpected* colour change, like a green banana turning yellow, is a chemical change (ripening).
"Chemical changes are always permanent."	While most are difficult to reverse, some chemical reactions are reversible. However, for Grade 7, it's a good general rule that they are not easily reversed, unlike physical changes (e.g., you can freeze water back into ice).

vi. Practice Problems with Step-by-Step Solutions

Problem 1: Classify the following changes as either Physical or Chemical. Give a reason for your answer.

- Melting a chocolate bar
- Frying an egg
- Mixing sand and water
- A firework exploding

Solution 1:

Melting a chocolate bar: Physical Change.

- **Reason:** The chocolate has only changed its state from solid to liquid. It is still chocolate and will become solid again if cooled. No new substance is formed.

Frying an egg: Chemical Change.

- **Reason:** The clear egg white turns white and solid, and the yolk firms up. This involves a change in colour and texture. The cooked egg is a new substance with different properties. The change is irreversible.

Mixing sand and water: Physical Change.

- **Reason:** The sand and water are just mixed. No new substance is formed. You can separate them by filtering or letting the sand settle.

A firework exploding: Chemical Change.

- **Reason:** The explosion produces light, sound, and heat (energy change). New substances (gases, smoke) are formed. This is a rapid chemical reaction.

Problem 2: You mix a clear liquid

- (Liquid A) with another clear liquid
- (Liquid B) in a beaker.

You observe two things: the beaker feels warm, and a white solid powder settles at the bottom. Was a chemical change likely to have occurred? Explain your answer using evidence.

Solution 2:

Answer: Yes, a chemical change very likely occurred.

Evidence and Explanation:

- **Energy Change:** The beaker feeling warm indicates that heat was released (an exothermic reaction). This is a key sign of a chemical change.
- **Formation of a Precipitate:** The white solid powder that formed from two clear liquids is a precipitate. The formation of a new solid substance is another key sign of a chemical change.

vi. Summary of Main Concepts

- A chemical change creates a new substance with new properties. A physical change only alters the form or state of a substance.
- Chemical changes are also called chemical reactions.
- The starting materials are reactants, and the new substances formed are products.
- Look for key indicators:
- Unexpected colour change
- Gas production (bubbles)
- Formation of a precipitate (solid)
- Energy change (heat, light, sound)
- Examples of chemical changes include rusting, burning, cooking, and digestion.
- Chemical changes are generally not easy to reverse.