6

"Nothing is waste until we waste it." – Thomas Edison

Materials Around Us

The Big Question

Imagine building a house without wood or bricks, or trying to drink water from your hands without a glass. Everything we see, touch, and use is made of something! What are these "somethings," and why are they so different from each other? This chapter will unveil the fascinating world of materials—how they are categorized, what properties they have, and why we choose specific ones for different purposes!

Meet EeeBee.AI

Hello, curious material scientists! I'm EeeBee, your AI buddy. Let's investigate materials—their properties, how we sort them—and see why they're chosen for tasks!

Still curious? Talk to me by scanning the QR code.

Learning Outcomes

By the end of this chapter, students will be able to:

- Identify and understand the variety of materials present in their surroundings.
- Classify materials based on their characteristics, such as texture, appearance, and usage.
- Analyze the properties of materials frequently used in daily life.
- Explore the connection between the properties of materials and their specific applications.
- Relate the properties of materials to their practical uses in daily life and environment.

From Last Year's Notebook

- Matter, Solutions, and Their Properties
- Methods of Separating Substances

Science Around You

Materials are the building blocks of our world. From the clothes we wear, the food we eat, and the houses we live in, to the advanced technology in our phones and cars, everything is made from various materials. Understanding their properties allows engineers to design better products, scientists to discover new substances, and all of us to make informed choices about what we use daily.

NCF Curricular Goals and Competencies

This chapter aligns with the following curricular goals and competencies:

CG-4 (C 4.1, 4.2, and 4.3): Applies scientific methods to measure length and observe different types of motion in daily life. **CG-5 (C 5.1):** Develops analytical skills by relating measurements and motion to broader physical concepts.

Mind Map

Materials Around Us

Materials Around Us

- **Hardness:** Ability to resist scratching or deformation
  - ✓ **Examples:** Hard materials (diamond, steel), Soft materials (rubber, wood)
- **Lustre:** The way a material reflects light
  - ✓ **Examples:** Shiny (metal), Dull (wood, rubber)
- **Transparency:** The ability of a material to let light pass through
  - ✓ **Types:** Transparent (glass), Translucent (frosted glass), Opaque (wood, metal)
- **Conductivity:** Ability to conduct heat or electricity

  Types:
  - ✓ Electrical Conductors (metals)
  - ✓ Insulators (plastic, rubber)
  - ✓ Thermal Conductors (copper)
  - ✓ Thermal Insulators (wood, plastic)

Grouping Materials According to Their Characteristics

- **Properties of Materials**
  - ✓ **Solubility**
  - ✓ **Soluble:** Dissolve in solvent (salt in water)
  - ✓ **Insoluble:** Do not dissolve (sand in water)
  - ✓ **Density:** Mass per unit volume
  - ✓ **Examples:** Denser materials (metals, stones), Less dense materials (wood, plastic)
  - ✓ **Volume:** The space occupied by a material
  - ✓ **Measured in:** Cubic centimeters (cm^3) or liters
  - ✓ **Texture:** The feel or appearance of the surface
  - ✓ **Types:** Smooth (glass), Rough (stone, wood)

Characteristics of Frequently Used Materials

- **Wood**
  - ✓ **Properties:** Natural, renewable, fibrous
  - ✓ **Uses:** Furniture, paper, building materials
  - ✓ **Characteristics:** Soft, varying textures, porous, biodegradable
- **Plastic**
  - ✓ **Properties:** Synthetic, malleable, lightweight
  - ✓ **Uses:** Packaging, containers, toys, medical products
  - ✓ **Characteristics:** Non-biodegradable, can be molded, flexible
- **Metal**
  - ✓ **Properties:** Conductive, durable, malleable
  - ✓ **Uses:** Construction, machinery, electronics
  - ✓ **Characteristics:** Shiny, heavy, high melting point, excellent conductor of heat and electricity
- **Glass**
  - ✓ **Properties:** Transparent, brittle
  - ✓ **Uses:** Windows, bottles, mirrors, lenses
  - ✓ **Characteristics:** Smooth, rigid, easily breakable, can be molded into shapes

In Focus

- Materials Around Us
- Grouping Materials According to Their Characteristics
- Characteristics of Frequently Used Materials

Introduction

Measurement is a fundamental aspect of understanding the physical world, allowing us to quantify and analyze various phenomena. Length, as a basic physical quantity, is essential for defining the size and distance of objects, while motion involves the study of how objects change position over time. In this chapter, we explore the tools and techniques used for accurate measurement of length, ranging from simple scales to advanced instruments like vernier calipers.

From History's Pages

Early humans relied on naturally available materials like stones, wood, and animal skins for tools and shelter. The discovery of metals, such as copper and bronze, marked the beginning of the Bronze Age, leading to significant advancements in tools and weapons. Later, the Iron Age revolutionized construction and trade with stronger materials. Natural materials like wood, clay, and metals were initially harnessed, followed by the invention of synthetic materials such as plastic in modern times.

Materials around us

The world is teeming with a fascinating diversity of living and non-living things, each uniquely shaped, colored, and serving a variety of purposes. These entities are crafted from a wide range of materials, including cotton, glass, metal, mud, paper, plastic, and wood.

Materials form the foundation of everything we see around us—they are substances that enable the creation of countless objects. While some things, like trees or buildings, are visible to the naked eye, others, such as air or microscopic organisms, remain hidden from plain sight but are no less vital to our world.

Classification of Mtaterials

The classification of materials is the process of systematically grouping them based on their distinct physical and chemical properties. This organization helps in understanding their nature and in selecting appropriate materials for specific uses in industries, construction, manufacturing, and daily life.

Materials possess a wide variety of properties such as hardness, appearance, transparency, and conductivity. By observing and analyzing these characteristics, materials can be classified into different categories. Some of the major classifications are explained below:

Hardness

Hard Materials

Hard materials are those which resist changes in their shape when a force is applied. They do not bend, compress, or deform easily. These materials are often used where strength and durability are required.

Examples include metals like iron and steel, and natural substances like stone. These are used in the construction of buildings, machines, and tools because of their ability to withstand wear and pressure.

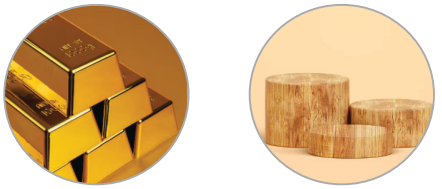
Hard Soft

Fig. 6.1 Hard and Soft Materials

Soft Materials

Soft materials are those that can be easily compressed, bent, or shaped when a small force is applied. These materials are commonly used in making comfort products or items where flexibility is needed.

Examples include cotton, sponge, and rubber. Cotton is used for making fabrics and **bedding**, while sponge is used in cleaning products because of its softness and **absorbency**.



Lustrous Non-Lustrous

Fig. 6.2 Lustrous Materials

Lustre

Lustrous Materials

Lustrous materials are those that reflect light from their surfaces and appear shiny. Their shine can make them visually attractive and is often used in decorative items.

Examples include gold, silver, and glass. Metals like gold and silver are used for making jewelry, while glass is used in mirrors and windows for its reflective property.

Non-lustrous Materials

Non-lustrous materials have a dull appearance and do not reflect light effectively. These are used where shine or reflection is not required.

Examples include wood, clay, and rubber. These materials are commonly found in furniture, pottery, and household items.

Transparency

Transparent Materials

Transparent materials are those that allow light to pass through completely, enabling clear visibility of objects on the other side.

An example of a transparent material is clear glass, which is used in windows and spectacles.

Fig. 6.3 Transparent Glass

Fig. 6.4 Opaque Copper Pipe

Opaque Materials

Opaque materials do not allow any light to pass through them. Objects behind them cannot be seen at all.

Examples include wood, metal, and stone. These materials are used where privacy or light blocking is required.

Keywords

Bedding: Materials used to make a bed comfortable and suitable for sleeping. Ex: sheets, blankets, duvets, pillows, and mattress covers.
Absorbency: The ability of a material to take in and hold liquid. Ex: towels, diapers, and sponges.

Translucent Materials

Translucent materials allow some light to pass through, but not enough to see clear images on the other side.

Examples include frosted glass and thin fabrics. Such materials are used in lampshades and bathroom windows to diffuse light.

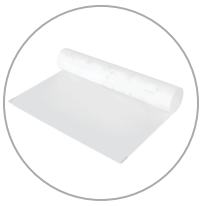


Fig. 6.5 Translucent Butter Paper

Conductivity

Conductors

Conductors are materials that allow the flow of electricity or heat through them efficiently. These materials are essential in electrical wiring, cooking utensils, and heat exchangers.

Examples include metals like copper and aluminum. Copper wires are widely used in electrical circuits due to their high conductivity.

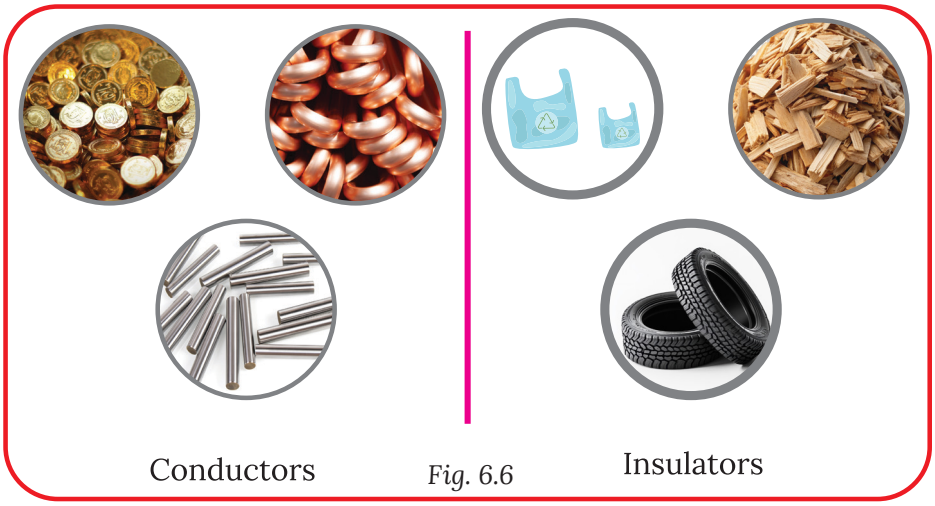


Fig. 6.6

Insulators

Insulators are materials that do not allow the flow of electricity or heat. These are used to protect against electric shocks or to maintain temperature.

Examples include plastic and rubber. Plastic coatings on wires and rubber handles on tools ensure safety from electric current.

Insulators Conductors

Property	Categories	Examples
Hardness	Hard	Metal, Stone
	Soft	Cotton, Sponge
Lustre	Lustrous	Gold, Glass
	Non-lustrous	Wood, Clay
Transparency	Transparent	Clear Glass
	Opaque	Wood, Metal
	Translucent	Frosted Glass
Conductivity	Conductor	Copper, Aluminum
	Insulator	Plastic, Rubber

Fact Flash

Did you know that the earliest humans used simple materials like stone, wood, and animal hides to make tools and shelters? The discovery and mastering of new materials, like metals (copper, bronze, iron), marked huge leaps in human civilization, shaping entire historical periods like the "Stone Age" or "Iron Age"!

Common Misconceptions

× **Misconception:** All shiny things are metals.

✓ **Correction:** While many metals are shiny (lustrous), other materials like glass or certain plastics can also be designed to appear shiny, but they do not share other properties of metals like conductivity.

× **Misconception:** All plastics are the same and cannot be recycled.

✓ **Correction:** Plastics come in many different types, each with unique properties. Many plastics are recyclable, but they need to be sorted and processed according to their specific type.

Science Around You

The world around us is composed of an astonishing variety of materials. From natural substances like wood, stone, and cotton to man-made materials such as plastic, glass, and concrete, each possesses unique characteristics. These materials can be broadly classified based on their origin (natural or man-made) or their state (solid, liquid, gas). Understanding materials is crucial in science and technology, as it helps us choose the right substance for a specific purpose. For instance, we use soft, absorbent cotton for clothing but hard, durable steel for tools. Scientists continually explore and develop new materials with enhanced properties, like super-strong alloys for spacecraft or biodegradable plastics.

Activity

Classifying Objects by Properties

Objective: To classify various common objects based on their observable physical properties.

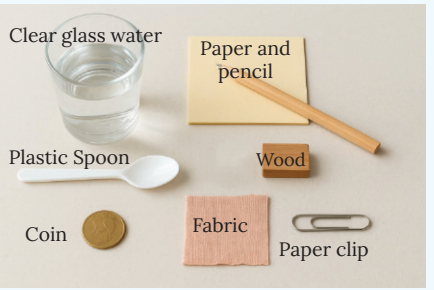


Fig. 6.7 Materials Required

- **Materials:**
  - A collection of diverse objects (e.g., a coin, a plastic spoon, a small piece of wood, a piece of fabric, a paper clip)
  - A clear glass of water
  - Notebook and pen/pencil
- **Procedure:**
  1. **Gather Objects:** Collect 6-8 different objects.
  2. **Observe Appearance:** For each object, note its appearance (e.g., shiny, dull, smooth, rough).
  3. **Test Hardness:** Gently try to scratch each object with your fingernail or another object (e.g., a paper clip, but be careful not to damage anything!). Note if it's hard or soft.
  4. **Test Float/Sink:** Gently place each object in the glass of water. Observe whether it floats or sinks.
  5. **Test Transparency:** Try to look through the object. Is it transparent (clear), translucent (blurry), or opaque (blocks light)?
  6. **Record and Group:** Create a table in your notebook and record all properties for each object. Then, group objects based on one or more shared characteristics (e.g., "All objects that float").
- **Observation:** Notice how different objects can have similar properties, allowing them to be grouped, and how some objects combine properties from different categories.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which of the following is an example of a hard material?
   (a) Cotton ☐ (b) Sponge ☐
   (c) Iron ☐ (d) Rubber ☐
2. Which of the following materials is an insulator?
   (a) Copper ☐ (b) Aluminum ☐
   (c) Rubber ☐ (d) Iron ☐

Understanding

3. What property makes glass suitable for use in mirrors and decorative items?
   (a) Hardness ☐ (b) Conductivity ☐
   (c) Transparency ☐ (d) Lustre ☐

Short Answer Question:

Applying

4. Name two soft materials and explain through examples why they are useful for making flexible objects.
5. Explain the meaning of "lustrous" and give one material that shows this property and one that does not.

Long Answer Question:

Analyzing

6. Why do we classify materials based on their properties? Explain briefly how hardness and transparency help in selecting materials for different uses, giving one example of each.

Grouping Materials According to Their Characteristics

Properties of Materials

The materials we use every day are selected based on their properties and how well they meet our needs. For instance:

- Cotton clothes are preferred in summer because they are lightweight and absorb sweat, helping to keep the body cool.
- Woollen clothes, on the other hand, are ideal for winter as they trap heat and keep the body warm.
- Materials like glass, plastic, and steel are often used to store liquids due to their specific properties like durability and non-reactivity.

Now, let's explore some key properties of materials that influence their uses:

Solubility: Soluble or Insoluble

Solubility is the ability of a material to dissolve in a solvent, such as water. This property determines how certain substances interact with liquids.

Soluble Materials: These substances dissolve completely in water. Examples include salt and sugar, which disappear into the water upon mixing.

Insoluble Materials: These substances do not dissolve in water. Examples include chalk, sand, and oil, which remain visible and separate even after being added to water.

Some liquids have the ability to completely mix with water, and these are known as miscible liquids. For example, lemon juice mixes fully with water, forming a uniform solution. On the other hand, certain liquids do not mix with water and form a separate layer when left undisturbed; these are called **immiscible liquids**, such as oil. Similarly, gases also exhibit varying degrees of solubility in water. For instance, oxygen is highly soluble in water, a property that plays a critical role in supporting the survival of aquatic animals and plants. However, not all gases dissolve in water, highlighting the diversity of material properties in our natural environment.

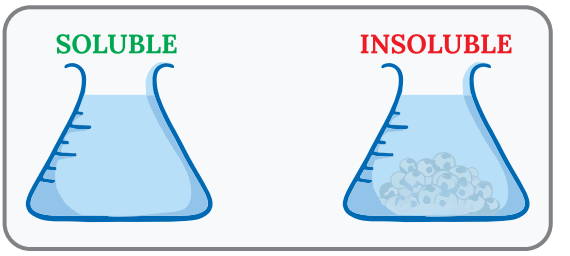


Fig. 6.8 Soluble and Insoluble

Density

- Density is a measure of how much mass a material contains within a given volume. This property plays a critical role in determining whether an object will float or sink in water.

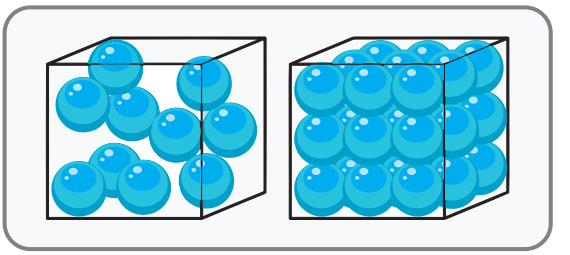


Fig. 6.9 Less and High Dense Materials

Floating and Sinking

- **Less Dense Materials:** These materials are lighter relative to water and tend to float. Examples include plastic balls, cooking oil, feathers, and air-filled balloons.
- **Denser Materials:** These materials are heavier relative to water and sink. Examples include iron nails, stones, and bricks.

Volume

Volume refers to the amount of space that an object or substance occupies. For liquids, the volume is often measured as the capacity of a container.

Example:

When water is poured from a jar into a glass, the glass may spill because its capacity is less than the jar's.

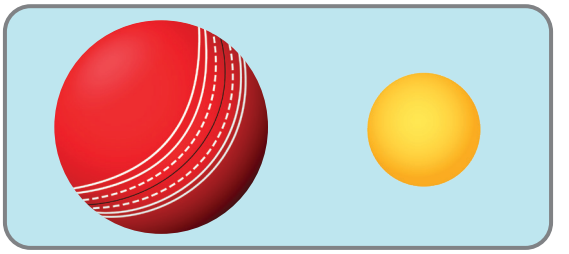


Fig. 6.10 Cricket and Tennis Ball

A cricket ball has more volume than a table tennis ball because it occupies more space.

Texture

The texture of a material refers to how it feels when touched, whether it is rough or smooth. This property is determined by the surface characteristics of the material.

- **Rough Materials:** These have uneven surfaces with noticeable **ridges** and bumps. When you run your hand over them, you can feel the irregularities. Examples include the bark of trees and bricks.


Fig. 6.11 Rough and Smooth

- **Smooth Materials:** These have even surfaces without any ridges or bumps, giving them a sleek and polished feel. Examples include paper and glass sheets.

Keywords

Immiscible Liquids: Liquids that are unable to mix and form a homogeneous solution. When combined, they will separate into distinct layers, like oil and water.
Ridges: Raised lines or bumps on a surface that make it feel uneven and not smooth.

Comprehensive Table of Material Properties

Property	Definition	Types	Examples
Solubility	Ability of a substance to dissolve in water or mix with liquids.	Soluble, Insoluble; Miscible, Immiscible easily.	Soluble: Salt; Insoluble: Oil
Density	Determines whether a material sinks or floats in water.	Less dense (floats), More dense (sinks) and experiments.	Floats: Oil; Sinks: Nails, Stones
Volume	The space occupied by a material or object.	Higher volume occupies more space	Cricket Ball > Table Tennis Ball
Texture	Surface feel of the material.	Smooth, Rough	Smooth: Glass; Rough: Bark

Fact Flash

Did you know that early scientists tried to classify all matter into just four "elements": Earth, Air, Fire, and Water? While we now know there are many more elements, this shows the ancient human desire to categorize and understand the world based on observable characteristics!

Common Misconceptions

× **Misconception:** All liquids are alike and mix easily.

✓ **Correction:** Liquids have different properties; some are immiscible (don't mix), like oil and water. They also have different densities and viscosities.

× **Misconception:** Hardness means a material won't break.

✓ **Correction:** Hardness refers to a material's resistance to scratching. A hard material like glass can still be brittle and break easily if dropped or impacted.

Science Around You

Have you noticed that raincoats keep us dry while sponges soak up water easily? Materials around us behave differently because they have special properties like waterproofing, transparency, or heat conduction. These unique characteristics help us choose the right materials for our daily needs and safety.

Activity

Group and Test Materials

Objective: Identify and group materials based on **Solubility, Density, Texture, and Volume**.

- **Materials:** Salt, Sand, Oil, Iron nail, Cricket ball, Table tennis ball, Glass, Bark.

1. **Test Solubility:**

   Mix salt, sand, and oil in water.

   Observe which dissolve (**soluble**) and which do not (**insoluble**).

Fig. 6.12 Materials Required

2. **Check Density:**
   Put iron nail, plastic ball, and oil in water.
   See what **floats** and what **sinks**.
3. **Compare Volume:**
   Compare a cricket ball and a table tennis ball.
   Identify which takes up **more space**.
4. **Feel Texture:**
   Touch glass and bark.
   Identify **smooth** and **rough** surfaces.

Quick Table to Record:

Material	Solubility	Floats/Sinks	Texture	Volume (Small/Big)
Salt	Soluble	-	-	-
Iron nail	Insoluble	Sinks	Smooth	Small
Cricket ball	-	-	-	Big

Conclusion: Materials are grouped by their **properties**, which help us choose them for different uses.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which of the following materials is insoluble in water?
   (a) Sugar ☐ (b) Salt ☐
   (c) Sand ☐ (d) Lemon juice ☐
2. Which material is most suitable for making summer clothes?
   (a) Wool ☐ (b) Cotton ☐
   (c) Plastic ☐ (d) Glass ☐

Understanding

3. Which material would most likely float on water?
   (a) Stone ☐ (b) Iron nail ☐
   (c) Cooking oil ☐ (d) Brick ☐

Applying

Short Answer Question:

4. Give two examples of substances that dissolve in water and two examples that remain insoluble in water.
5. Explain what is meant by the volume of an object and give one clear example to demonstrate it.

Analyzing

Long Answer Question:

6. Explain how the properties of solubility and density help us decide the use of materials in daily life. Give one example for each property.

Characteristics of Frequently Used Materials

Materials are all around us. Everything we see, touch, or use is made from some kind of material. Some are natural, like wood and metals found in the earth, while others, like plastics and glass, are made by humans. Each material has its own special qualities, called properties, that make it useful for certain purposes. By observing and understanding these properties, we can learn why some materials are used to make furniture, others to make bottles, and still others to make buildings or tools.

Wood

One of the most common natural materials we use is wood, which comes from trees. Wood is a material that feels hard and rough when we touch it. It does not shine like metal or glass; instead, it has a dull appearance unless it is polished. If you place a piece of wood in water, you will find that it does not dissolve. Wood is an opaque material, meaning you cannot see through it. Interestingly, some types of wood float on water because their density is lower than that of water. Because of these features, wood is widely used to make furniture, doors, houses, and even paper.

Fig. 6.13 Wood

Fig. 6.14 Plastic

Plastic

Plastic, unlike wood, is a man-made material. It is one of the most versatile materials we use today. You will find plastic in your toys, bottles, buckets, and even in packaging materials. Plastic usually looks dull but can be made shiny, depending on how it is manufactured. Some plastics are hard and strong, like the plastic used in chairs and bottles, while others are soft and flexible, like plastic bags. Like wood, plastic does not dissolve in water, and it often feels smooth. Plastic can be opaque, allowing no light to pass through, or translucent, letting some light pass but not enough to see clearly through it. Since it is lighter than water, many plastic objects float when placed in water.

Glass

Another important material is glass. We see glass in windows, mirrors, bottles, and even in the screens of our gadgets. Glass has a shiny, smooth appearance and is made by heating sand and other substances at very high temperatures. When cooled, it becomes hard. However, if it is heated again to its melting point, glass can become soft and be reshaped. Unlike wood or plastic, glass can be transparent, allowing us to clearly see through it. Sometimes, glass is made translucent, like the frosted glass in bathroom windows, or opaque, as seen in decorative items. Glass does not dissolve in water, and because its density is higher than water, glass sinks when placed in it.

Fig. 6.15 Glass

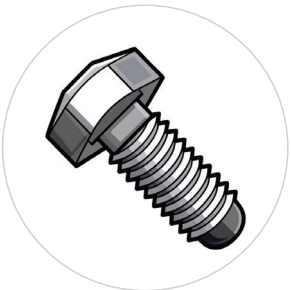


Fig. 6.16 Metals

Metals

Metals are found naturally in the Earth and are widely used for their strength and durability. Materials like iron, copper, aluminum, and gold are all metals. Metals usually have a shiny, lustrous appearance and are smooth to touch. They are generally hard, although some, like gold and silver, are softer and easier to shape. Metals do not dissolve in water and are opaque, so light cannot pass through them. Unlike wood and plastic, metals are heavier than water, so they sink when placed in it. Metals are essential for building bridges, cars, tools, wires, and many other objects that need strength and durability.

Matter: The Fundamental Building Block of Everything

Definition and Properties of Matter

Matter is defined as anything that has mass and occupies space. It forms the basic substance of everything in the universe, both living and non-living. Matter has two essential physical properties:

- **Mass:** The quantity of matter in an object. It is measured using standard units such as grams (g) and kilograms (kg). The kilogram (kg) is the unit of mass in the International System of Units (SI). When writing the measurement, the correct format is to leave a space between the numerical value and the unit. For example: 7 kg, not 7kg or 7kgs.
- **Volume:** The amount of space occupied by matter. Volume is measured in litres (L) or millilitres (mL) for liquids, and cubic metres (m^3) for larger volumes of solids. In the SI system, the cubic metre (m^3) is the standard unit. A space is left between the numerical value and the unit symbol, for example: 2 m^3 or 500 mL. Note that "L" is written in uppercase, while "m" in millilitre is lowercase.

Examples of Matter in the Environment

Matter can be found in both living and non-living forms.

- Living matter includes plants, animals, and humans.
- Non-living matter includes objects like stones, water, air, and plastic items.

All these materials share the same basic properties of having mass and occupying space, even though their specific characteristics and uses differ.

Why Is Matter Important?

Matter is the basic building block of the universe. Everything we touch, feel, and see exists because of matter. It forms the objects that we interact with every day and allows us to sense the world around us. Without matter, nothing physical would exist.

Matter is present in different states—solids, liquids, and gases. Solids like wood and metal have a fixed shape and volume. Liquids like water and oil have a definite volume but take the shape of their container. Gases, such as the air we breathe, have neither a fixed shape nor a fixed volume and spread to fill the entire space available to them.

Historical Perspective on the Classification of Matter

The concept of classifying matter based on its properties is ancient. In Indian traditional knowledge systems such as Ayurveda, matter was classified according to twenty properties (known as gunas).

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(Aṣhtanga hṛidaya Sūtra sthāna 1.18)

These properties were grouped into ten pairs of opposite qualities that described all physical substances, living systems, food, and even environmental elements. These pairs include:

1. Heavy (guru) and light (laghu)
2. Slow (manda) and sharp or quick (tīkṣṇavn)
3. Cold (hima) and hot (uṣṇa)
4. Oily (snigdha) and dry (rukṣha)
5. Smooth (ślākṣṇa) and rough (khara)
6. Solid (sāndra) and liquid (drava)
7. Soft (mṛidu) and hard (kaṭhina)

8. Stable (sthira) and unstable or moving (chala)
9. Subtle (sūkṣhma) and gross or big (sthūla)
10. Non-slimy (viśhada) and slimy (picchhila)

This classification allowed scholars to describe not just the physical state of matter but also its behavior and interaction with other materials or living beings.

Bringing It All Together

From natural materials like wood and metal to man-made ones like plastic and glass, each material's properties help decide how it is used in our daily life. Wood's hardness and lightness make it perfect for furniture, plastic's lightness and flexibility make it useful for packaging, glass's transparency makes it ideal for windows, and metal's strength makes it essential for construction and manufacturing. And behind all of these materials lies matter, the invisible but essential substance of the universe.

Understanding the properties of different materials helps us make smart choices in how we use them, care for them, and invent new things. As you learn more about the world, you'll see that whether you are looking at a pencil, a bottle, or a building, you are always observing matter at work.

Fact Flash

Did you know that paper, a very common material, was invented in ancient China more than 2000 years ago? Before that, people wrote on things like papyrus, clay tablets, or animal skins, showcasing how new materials can drastically change human communication and progress!

Common Misconceptions

× **Misconception:** All metals are magnetic.

✓ **Correction:** Only certain metals like iron, nickel, and cobalt are magnetic. Aluminum and copper, for example, are metals but are not magnetic.

× **Misconception:** Glass is a liquid that flows very slowly.

✓ **Correction:** Glass is an amorphous solid. It is not a liquid; its atoms are rigidly fixed, but without a regular crystalline structure.

Science Around You

Our daily lives are deeply intertwined with the characteristics of commonly used materials like plastic, metal, wood, glass, and fabric. Each material possesses a unique set of properties that make it suitable for specific applications. For example, plastics are lightweight, versatile, and can be molded into various shapes, making them ideal for containers, toys, and electrical insulation. Metals like iron and aluminum are strong, durable, good conductors of heat and electricity, and are widely used in construction, vehicles, and cookware. Wood is a natural, renewable resource, strong for its weight, and a good insulator, perfect for furniture and housing structures. Glass is transparent, waterproof, and non-reactive, making it essential for windows, bottles, and optical lenses. Fabrics (like cotton, wool, nylon) are soft, flexible, and can be absorbent or water-resistant, making them suitable for clothing, upholstery, and various textiles.

Activity

Material Exploration and Use

Objective: To identify and describe the characteristics of common materials and relate them to their uses.

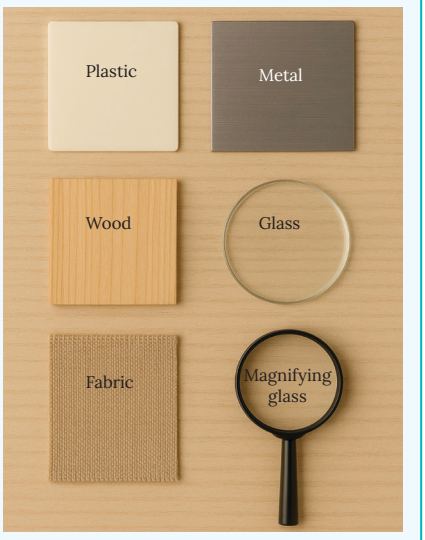


Fig. 6.17 Materials Required

- **Materials:** Plastic, Metal, Wood, Glass, Fabric, Magnifying glass
- **Procedure:**
  1. **Examine Each Sample:** Take each material sample and observe it closely.
  2. **Describe Characteristics:** For each material, describe at least three observable characteristics. Consider properties like appearance, texture, flexibility, transparency, and approximate hardness.
  3. **Brainstorm Uses:** Think of at least three common objects or uses for each material.
  4. **Connect Characteristics to Uses:** For each use you listed, explain why the material's characteristics make it suitable for that particular purpose. For example, "Plastic is used for water bottles because it is lightweight, waterproof, and can be molded."
- **Observation:** Note how the specific properties of each material directly influence its primary applications in everyday objects.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which characteristic makes metal suitable for making electrical wires?
   (a) It is shiny ☐ (b) It is a good conductor of electricity ☐
   (c) It is very heavy ☐ (d) It is transparent ☐
2. Which material is best known for its transparency and resistance to water?
   (a) Plastic ☐ (b) Fabric ☐ (c) Glass ☐ (d) Metal ☐

Understanding

3. Why is wood commonly used for making furniture?
   (a) It is very flexible ☐
   (b) It is a natural insulator and strong for its weight ☐
   (c) It is transparent ☐ (d) It is magnetic ☐

Short Answer Question:

Applying

4. Name two properties that make plastic widely useful as a material for packaging goods.
5. Explain why cooking pots are usually made of metal but their handles are often made of plastic or wood.

Long Answer Question:

Analyzing

6. Imagine you are a product designer creating a new type of water bottle. Discuss the different materials you might consider for various parts of the bottle (body, lid, seal). How those characteristics contribute to the bottle's functionality, durability, and safety.

SUMMARY

Materials Around Us

Materials are the foundation of everyday objects, chosen for their specific properties. They can be natural, like wood or metals, or artificial, like plastics. Understanding their characteristics helps us use them effectively in daily and industrial life.

Grouping Materials by Characteristic

Materials are categorized based on their properties to determine their best uses:

- **State of Matter:** Solids (e.g., wood, metals) are used for construction, liquids (e.g., water, oils) for cooling and consumption, and gases (e.g., oxygen, CO_2) for breathing and combustion.
- **Appearance:** Lustrous materials like metals are shiny, while non-lustrous ones like wood are dull.
- **Hardness:** Hard materials (e.g., steel) resist wear, while soft ones (e.g., cotton) are flexible.
- **Transparency:** Materials are transparent (glass), translucent (frosted glass), or opaque (wood).
- **Solubility:** Some dissolve in water (salt), while others don't (oil).
- **Conduction:** Conductors like metals carry heat/electricity; insulators like rubber do not.

Characteristics of Frequently Used Materials

- Materials frequently used in everyday life have unique properties that make them indispensable:
- **Wood :** Lightweight, durable, and aesthetically pleasing, wood is widely used in furniture, construction, and tools. It is also biodegradable and environmentally friendly.
- **Metals :** Known for their strength, malleability, and conductivity, metals are essential in construction, transportation, and electronics. Examples include iron for building frameworks, aluminum for lightweight applications, and copper for electrical wiring.
- **Plastics :** Plastics are lightweight, flexible, and resistant to corrosion, making them ideal for packaging, household items, and medical equipment. However, their non-biodegradable nature poses environmental challenges.
- **Glass:** Transparent and easy to shape when heated, glass is used in windows, containers, and optical devices. Its brittle nature limits its usage in certain applications.
- **Fabrics :** Fabrics, both natural (cotton, wool) and synthetic (polyester, nylon), are flexible and comfortable, making them essential for clothing, upholstery, and industrial use.

Example Based Questions

1. **Which of the following materials is the best conductor of heat?**

   (a) Wood (b) Plastic

   (c) Copper (d) Rubber

   Answer: (c) Copper

   Explanation: Copper is a metal and metals are good conductors of heat. That is why cooking utensils and electric wires are often made of copper, whereas wood, rubber, and plastic are insulators that do not allow heat to pass easily.

2. **Which material will float on water?**

   (a) Iron nail (b) Plastic bottle cap

   (c) Stone (d) Glass marble

   Answer: (b) Plastic bottle cap

   Explanation: A plastic bottle cap is less dense than water, so it floats. Materials like stone, iron, or glass are denser than water and sink. This property of materials is used in making boats, ships, and life jackets.

Short Answer Questions

4. **Why are cooking utensils generally made of metals but their handles are made of wood or plastic?**

   Answer: Metals like aluminium, copper, and steel are good conductors of heat, so they allow heat to pass quickly and cook food evenly. However, this same property makes them unsafe to hold directly when hot. That is why handles are made of wood or plastic, which are poor conductors of heat (insulators). This combination ensures both efficient cooking and safety for handling hot utensils.

5. **Give two examples each of hard and soft materials. How does this property affect their use in daily life?**

   Answer: **Hard materials:** Iron, Stone

   Soft materials: Cotton, Clay

   Hard materials are difficult to compress and strong, which makes them suitable for construction, making machines, or furniture. Soft materials can be easily compressed or moulded, which makes them useful for making clothes, beds, and toys. This shows how the properties of materials decide their applications in our lives.

6. **A student observes that oil floats on water when mixed. What conclusion can be drawn about the density of oil compared to water?**

   Answer: When oil is poured into water, it does not mix and emains floating on the surface. This indicates that oil is less dense than water. Since less dense materials always float on denser ones, oil settles above water. This property is important in daily life, for example in oil spills on oceans where oil forms a layer above water, or in salad dressings where oil and vinegar separate.

Long Answer Questions

7. **Explain how materials can be grouped based on transparency. Give examples of transparent, translucent, and opaque objects, and describe how each type is used in daily life.**

   Answer: Materials can be grouped depending on how they allow light to pass through them:

   Transparent Materials: These allow light to pass completely, and objects behind them can be seen clearly. Examples: Glass, clear water, and clean plastic. Uses: Transparent glass is used in windows, spectacles, and car windscreens to see through clearly.

   Translucent Materials: These allow light to pass only partially. Objects behind them appear blurred or unclear. Examples: Butter paper, frosted glass, and oiled paper. Uses: They are used in lampshades, bathroom windows, or decorative lighting where light is needed but privacy should be maintained.

   Opaque Materials: These do not allow light to pass at all. Examples: Wood, metals, and stone. Uses: They are used to make doors, walls, cupboards, and furniture to block vision and provide strength.

   Thus, the property of transparency helps us decide whether a material should be used for allowing visibility (glass) or for blocking light (wood). This grouping is very useful in designing houses, vehicles, and everyday tools.

Gap Analyzer™
Complete Chapter Test

EXERCISE

A. Choose the correct answer.

1. What is the main reason for grouping materials?
   (a) To understand their uses ☐ (b) To make them attractive ☐
   (c) To dispose of them ☐ (d) To increase their weight ☐
2. Which of these is an example of a natural material?
   (a) Plastic ☐ (b) Wood ☐
   (c) Nylon ☐ (d) Glass ☐
3. Why are metals commonly used for making utensils?
   (a) They are flexible ☐ (b) They are poor conductors of heat ☐
   (c) They are shiny and strong ☐ (d) They are light and transparent ☐
4. What is the primary characteristic of glass that makes it useful for windows?
   (a) Transparency ☐ (b) Flexibility ☐
   (c) Conductivity ☐ (d) Opacity ☐
5. Which material is waterproof and used for raincoats?
   (a) Paper ☐ (b) Cotton ☐
   (c) Rubber ☐ (d) Jute ☐

B. Fill in the blanks.

1. Metals like _____ are used in electrical wiring due to their conductivity.
2. Wood is a _____ material and is used for furniture.
3. Rubber is elastic and can regain its _____ after stretching.
4. Plastic materials are often used because they are _____ and long-lasting.
5. Glass is _____ and allows light to pass through.

C. Write True or False.

1. All materials can conduct electricity. _____
2. Plastic is biodegradable and environmentally friendly. _____
3. Wood is an insulator and does not conduct electricity. _____
4. Transparent materials allow light to pass through. _____
5. Metals are brittle and break easily. _____

D. Define the following terms.

1. Material
2. Transparency
3. Conductor
4. Flexibility
5. Waterproof

E. Match the columns.

	Column A		Column B
1.	Metals	(a)	Elastic and stretchy
2.	Rubber	(b)	Transparent material
3.	Wood	(c)	Good conductor of heat
4.	Plastic	(d)	Lightweight and durable
5.	Glass	(e)	Natural and sturdy

F. Assertion and Reason

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.
(e) Both A and R are false.

1. **Assertion (A):** Glass is a suitable material for making windowpanes.
   Reason (R): Glass is transparent and allows light to pass through.
2. **Assertion (A):** A wooden block usually floats on water.
   Reason (R): Wood is generally denser than water.
3. **Assertion (A):** Metals are widely used for making cooking utensils.
   Reason (R): Metals are good conductors of heat.

G. Give reasons for the following statements.

1. Metals are used for making electrical wires.
2. Plastic is used for water bottles and containers.
3. Glass is ideal for making windows.
4. Rubber is used for making tires.
5. Wood is commonly used in furniture and construction.

H. Answer in brief.

1. Why is grouping materials important?
2. What are some uses of plastic in everyday life?
3. Why is wood preferred for furniture?
4. Explain the difference between transparent and opaque materials.
5. How does the elasticity of rubber make it useful?

I. Answer in detail.

1. Describe the characteristics of commonly used materials.
2. Explain the importance of grouping materials with examples.
3. How are metals and plastics different in their properties and uses?
4. Discuss why some materials are better suited for specific purposes.
5. Compare the characteristics of natural and synthetic materials.

SKILL-BASED PRACTICE

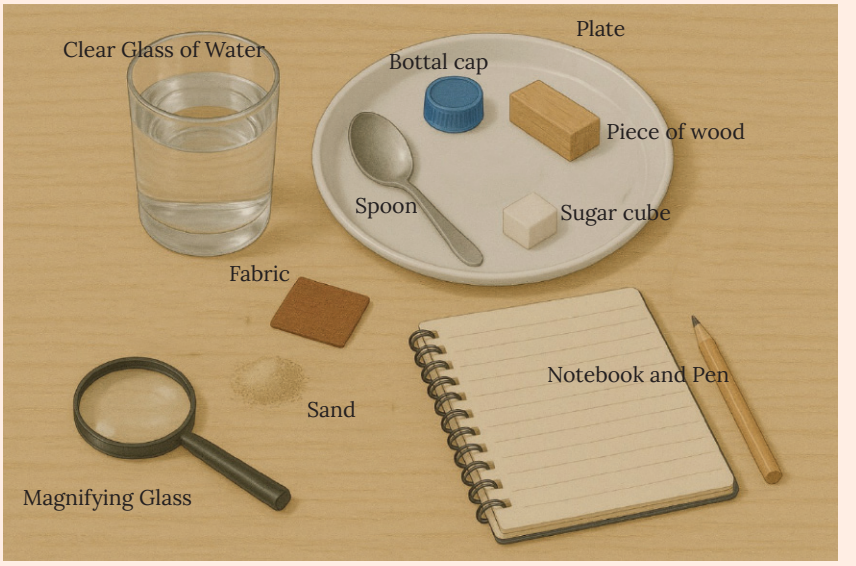
Activity Time

STEM

Material Properties Investigation

Materials Needed:

- Various small objects/samples (e.g., metal spoon, plastic bottle cap, piece of wood, glass piece, paper, fabric swatch, a sugar cube, sand)
- A clear glass of water
- A shallow tray or plate
- A magnifying glass (optional)
- Notebook and pen/pencil



Materials Required

Activity Steps:

1. **Set Up Stations:** Arrange your samples on a table.
2. **Appearance Check:** For each material, describe its color, lustre (shininess), and texture (smooth, rough).
3. **Hardness Test:** Gently try to scratch each material with a fingernail or the edge of a plastic spoon. Note if it's "hard" (not scratched easily) or "soft" (scratched easily).
4. **Solubility Test:** Place a tiny amount of sugar cube and a tiny bit of sand into separate small cups of water. Stir and observe if they dissolve.
5. **Float/Sink Test:** Gently place each solid object into the glass of water. Record if it floats or sinks.
6. **Record Data:** Create a table to document your observations for each material under each property tested.

Questions to Answer:

- Which materials were the hardest? Which were the softest?
- Which materials floated, and which sank? What does this tell you about their density compared to water?
- What is the difference between sugar and sand in terms of solubility in water?
- Based on your observations, which material would you choose for a waterproof container? Why?

Skills Covered: Observation, Classification, Data Recording, Material Property Identification

Creativity

Art

"Material World" Collage

Task: Create a vibrant collage using various small pieces of actual materials you find (e.g., fabric scraps, aluminum foil, tiny wood shavings, plastic bits from packaging, paper snippets). Arrange them artistically to represent different categories or uses of materials around us. Label each material clearly.

Materials to Use: Cardboard or thick paper as a base, Various material scraps (fabric, foil, wood, plastic, paper, cotton, etc.), Scissors (use carefully!), Strong glue. Markers or pens for labels

Materials Required

Questions to Answer:

- Which material was the easiest to cut and glue? Which was the most challenging?
- How did the different textures of the materials add to your artwork?
- Can you find any material on your collage that could be recycled?
- What does your collage tell you about the diversity of materials used in everyday products?

Skills Covered: Creativity, Material Recognition, Fine Motor Skills, Understanding Material Properties

Material Recycling Inquiry

Group Activity

Investigating Household Waste Materials

Activity Instructions: Work in a group (or individually at home with adult supervision).

1. **Collect Samples:** With permission, collect small, clean samples of different types of waste materials from your household recycling bin or general waste (e.g., a plastic bottle, an aluminum can, a glass jar, a piece of cardboard, a cloth scrap, a food wrapper).
2. **Categorize:** Group the collected samples into general material categories (e.g., Plastics, Metals, Glass, Paper/Cardboard, Fabric, Other).
3. **Research Recycling:** For each major category, research (using reliable online sources or local recycling guides) whether that type of material is generally recyclable in your area and what it can be recycled into.
4. **Discussion:** Discuss within your group the importance of sorting waste materials for recycling and the benefits of recycling.

Questions to Answer:

- Which types of materials did you find most commonly in your waste?
- Were all the materials you collected recyclable in your area? If not, why?
- How does the "characteristic" of a material (e.g., being able to melt and reform) relate to its recyclability?
- What are some benefits of recycling materials instead of throwing them away?

Skills Covered: Classification, Research & Information Gathering, Environmental Awareness, Critical Thinking, Teamwork (if done in groups)

The Best Material for a Raincoat

Case Study

A student wants to buy a new raincoat. She wants one that will keep her completely dry, be fairly lightweight, and be easy to fold and carry in her bag. She sees raincoats made of plastic, cotton, and wool.

Guiding Questions:

1. Which material (plastic, cotton, or wool) is best known for being waterproof?
2. Which material is generally heavy and absorbent, making it less suitable for a raincoat?
3. Why would a lightweight material be good for a raincoat that needs to be carried easily?
4. If the raincoat needs to be flexible so she can move easily, which material properties are important?
5. Based on the characteristics, which material should she choose for her raincoat to stay dry?

Skills Covered: Material Identification, Properties of Materials, Comparative Analysis, Decision Making

Modern Materials in Architecture

Source Based Question

Since the early 20th century, architects have often used glass blocks—semi-transparent building elements that let in light while maintaining privacy. These were patented in 1886 and became popular in architectural styles such as Art Deco

In recent years, scientists have developed an entirely new material called transparent wood, which achieves up to 90% transparency while preserving wood's strength and biodegradability. This innovative material is lighter, stronger than glass, and may someday be used as a sustainable alternative in windows or building components

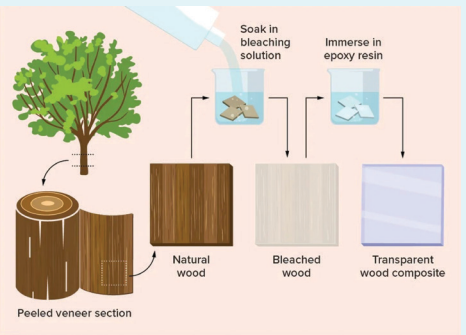


Image Credit: Knowable Magazine

Questions for Students

1. **Understanding the Source**
   a) What property makes glass blocks useful in buildings?
   b) How is transparent wood different from ordinary wood?
2. **Exploring Material Properties**
   a) Classify glass blocks and transparent wood as transparent, translucent, or opaque.
   b) Why might transparent wood be considered better than regular glass in some cases?
3. **Trends & Application**
   a) Describe one reason why architects used glass blocks in early modern buildings.
   b) How could transparent wood change the way we build homes in the future?

Skills Covered: Evaluation and Comparison, Functional Analysis, Scientific Reasoning