Science with Professor Alexey

SCIENCE JOURNAL

MODULE 1

Matter, Forces, and Amazing Machines

Grades 4–6

THIS JOURNAL BELONGS TO

Scientist's name _____ **Grade** _____

MODULE 1 · WEEK 1

Properties of Matter and Materials

THIS WEEK'S CLASSES

Class 1 Matter Is Stuff

Class 2 Particles, Atoms & Molecules

Class 3 Invisible Motion

READING MODULE 1 · WEEK 1 · CLASS 1

Matter and the Material World

What counts as matter, and what does not.

Date _____

A pencil, a rock, a splash of water, your own hand, and invisible air — all of it is matter.

Look around the room you are in right now. A table, a pencil, a glass of water, your own hand, and the air in the room may look completely different. Yet they all belong to one enormous category: matter.

Matter is the material part of the universe. It is not just things we can see. Some matter is solid, some is liquid, and some is invisible gas. The important question is not whether we can see it, but whether we can find evidence that it has mass and occupies volume.

A NOTE ON MATH SYMBOLS

A quick note on the symbols in this booklet, good for the whole module: a dot (·) always means 'multiplied by', and a slash (/) means 'divided by' or 'per' (as in g/cm³). You will see both whenever we work with numbers.

So What Is Matter?

Matter is anything that has mass and takes up space. Scientists often say that matter occupies volume. To test whether something is matter, ask two serious questions:

TEST 1 — MASS

Does it have mass? Would there be some amount to measure on a balance?

TEST 2 — VOLUME

Does it take up room, so that other matter cannot be in exactly the same place?

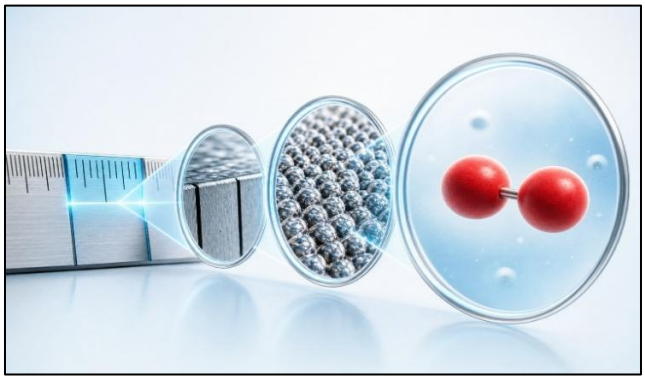
A rock, a pencil, a drop of water, and a piece of paper all pass both tests. They have mass, and they occupy space. They are matter.

A balance measures mass — test 1 for matter.

If you push on a balloon, it pushes back. Air occupies volume; it is matter.

SCALE CHECK: HOW SMALL IS "TINY"?

An oxygen molecule is roughly 0.346 nanometres across. If oxygen molecules could be placed side by side in a straight line, it would take about 29 million of them to make just 1 centimetre. That is why matter can look smooth even though it is made of particles.



YOUR TURN · JOURNAL ENTRY 1

Be a matter detective

Choose three objects near you. Give each one the two tests. Write what evidence tells you it is matter.

Gas, Such as Air, Is Matter, Even Though Invisible!

Air is the example that makes matter interesting. You cannot see it, and you cannot pick up a handful of it. But air still has mass and volume.

Try this evidence test: screw the cap tightly onto an empty plastic bottle and squeeze the bottle. It resists being crushed flat because air is trapped inside. The air occupies space. With a sensitive enough balance, you can also measure that air has mass.

The trapped air pushes back — evidence!

LAB IDEA: INVISIBLE ≠ "NOT THERE"

Air molecules are invisible, but we can detect them when they push on a bottle, move a balloon, carry smells, or let sound travel.

YOUR TURN · JOURNAL ENTRY 2

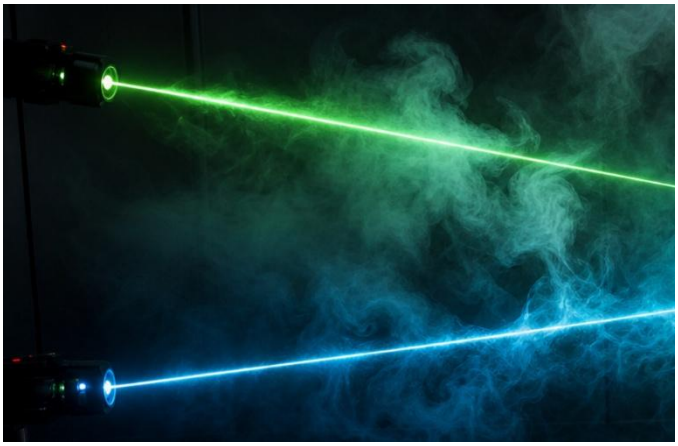
The bottle/balloon test

Try to squeeze a balloon or a plastic bottle with cap on (filled with water, or pop, or just air). Feel how it pushes back. What is your evidence that invisible air is matter?

Things That Are Real but Are Not Matter

Not everything real is made of matter. Light from a lamp is real: it can enter your eye, warm a surface, and help plants grow. But light is not a material object that has ordinary mass and occupies volume like a rock or a glass of water.

Heat, sound, and shadows are also not matter. Heat is energy being transferred. Sound is a wave (a vibration) travelling through matter. A shadow is a region where light is blocked. These are real effects, but they are not "stuff" in the same sense as matter.



Light is real — but it is not matter.

SCIENTIST'S TEST

When you are unsure, do not ask only "Can I see it?" Ask: Does it have mass? Does it occupy volume? What evidence could prove it?

YOUR TURN · JOURNAL ENTRY 3

Matter or not?

Check one box for each. Be ready to defend your answer with evidence!

☐ matter	☐ not matter	**Ice cube**
☐ matter	☐ not matter	**Sunlight through a window**
☐ matter	☐ not matter	**Bubbles in a pop drink**
☐ matter	☐ not matter	**Electric current in wires**
☐ matter	☐ not matter	**Drop of water**
☐ matter	☐ not matter	**Cloud in the sky**
☐ matter	☐ not matter	**Thunder**
☐ matter	☐ not matter	**House**
☐ matter	☐ not matter	**Virus**
☐ matter	☐ not matter	**Cat**
☐ matter	☐ not matter	**Rainbow**
☐ matter	☐ not matter	**Reflection in the mirror**

The Big Picture

Matter is the stuff of planets, oceans, pencils, food, machines, and living bodies. Once you know how to test for matter, you can start to understand how the visible world is built from invisible pieces.

This week you will begin thinking like a scientist who studies matter. You will look at ordinary objects, invisible air, and think of tiny particles that make up all matter – **atoms** and **molecules**. We will learn a way of asking better questions about the physical world, give answers that are well grounded in science, and make connections.

From a pencil to a planet — all matter is built from the same building blocks.

Words to Know

matter — anything that has mass and occupies volume.

mass — a measure of how much matter an object contains.

volume — the amount of space an object or substance occupies.

evidence — information from observations or measurements that helps answer a question.

particle — a tiny piece or unit of matter.

atom — a basic building block of ordinary matter.

molecule — two or more atoms joined together.

YOUR TURN · JOURNAL ENTRY 4

Draw it!

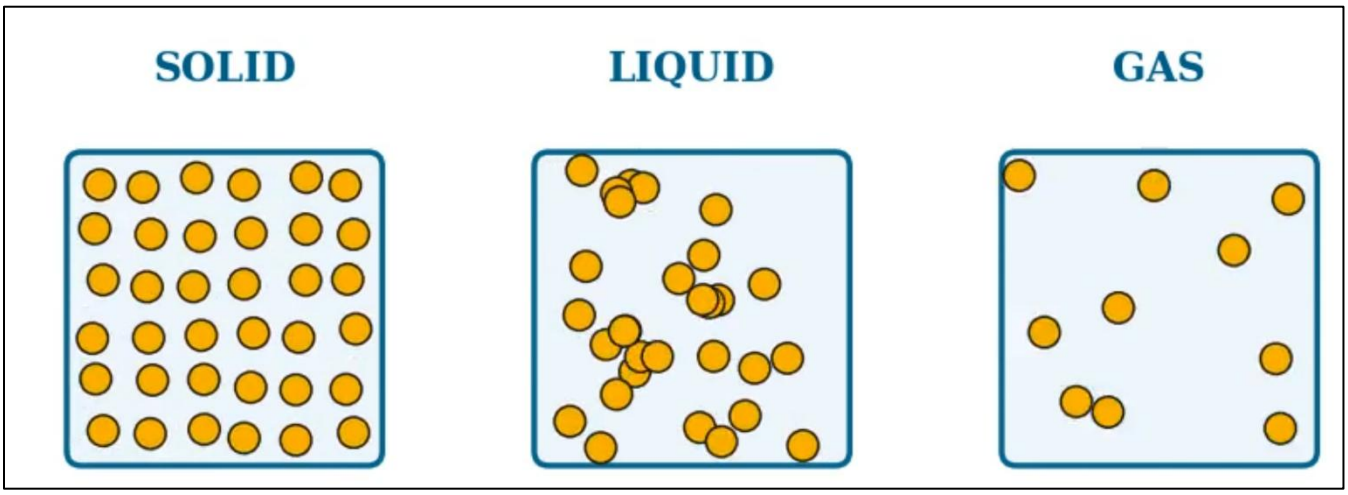
Pick one word from the list and draw a picture that explains it. Label your drawing.

ADDITIONAL READING FOR STUDENTS WHO WANT A STRONGER PICTURE

Matter, Energy, and Evidence

The definition “matter has mass and occupies volume” is a useful starting point, but science becomes more interesting when we ask how we know it is true. We cannot see individual air molecules with our eyes, yet we can measure their effects. Air pushes on the inside of a bottle, fills a balloon, carries smells, and lets sound travel. These observations are evidence for invisible matter.

A good scientific model connects many observations at once. The particle model says that matter is made of tiny moving particles. This helps explain why gases can spread through a room, why liquids can flow, and why solids keep their shape. The same model also helps explain why heating matter often makes it expand: its particles usually move more rapidly and need more space.



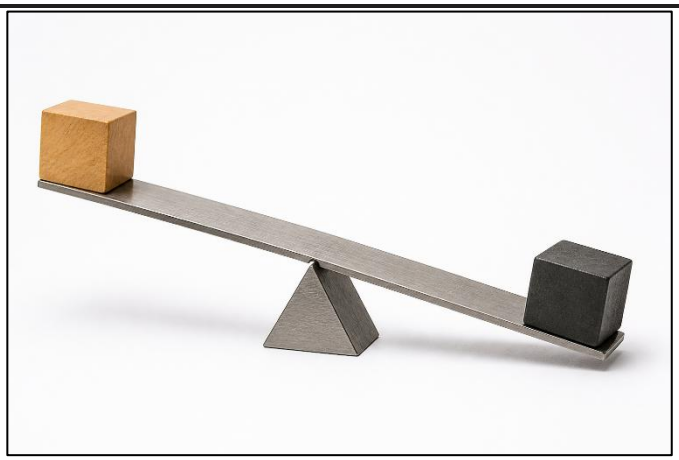
One substance, three states: solid, liquid, gas.

Mass, Volume, and Density

Two objects can have the same volume but very different masses. A block of wood and a block of iron may take up the same amount of space, but the iron has much more mass. Scientists describe this using **density**.

USEFUL RELATION

density = mass ÷ volume. A material with more mass packed into the same volume has a higher density.



Wood vs iron: same volume, different mass.

Matter is different from energy, but matter and energy interact constantly. Light is not ordinary matter, yet matter can absorb light, reflect it, or emit it. Heat is not a substance flowing like water; it is energy being transferred because particles are moving and interacting. A metal spoon feels cold at first because energy moves from your hand into the spoon quickly.

Science is not limited to what is easy to see. Scientists use measurements, experiments, and models to understand things far beyond ordinary vision: molecules in air, atoms in a crystal, and even matter inside distant stars.

Even distant stars are made of the same elements as common things around us.

Scientific Terms

observation — something noticed carefully, often with the help of instruments.

measurement — a number and unit found by comparing something with a standard.

particle model — the idea that matter is made of tiny moving particles.

density — mass divided by volume; how much matter is packed into a certain space.

energy — the ability to cause change or do work.

interaction — a way in which one thing affects another

YOUR TURN · JOURNAL ENTRY 5

The big question

A friend says: “If I can’t see it, it isn’t real.” Use what you read today to change their mind. What evidence would you show them?

BEFORE YOU FINISH — CHECK YOURSELF

- ☐ I can say the two tests for matter.
- ☐ I can explain why invisible air is still matter.
- ☐ I finished all my journal entries.
- ☐ I found one new question I want to ask Professor Alexey.