Describe how historical ideas and models furthered our understanding of the nature of matter. Include: Greek ideas, alchemy, Lavoisier
What is Chemistry?

*Chemistry* is the science that studies **MATTER**.

What is **MATTER**?

- **MATTER** is anything which has **MASS**!
  - Note that **MASS** and **WEIGHT** are **NOT** the same thing!!!

- Something with mass weighs something, **and** takes up **VOLUME**. **Mass is CONSTANT**.

A text book has **MASS**, therefore it is made of **MATTER**, but what is matter made of?

The ancient **GREEK PHILOSOPHERS** wanted to answer this question, so they looked at how matter behaves, then speculated about what it’s made of.
A bit of history...

450 B.C.
The Greeks did not have the capability, or desire to do any complicated EXPERIMENTS, so they focused on what happens on the SURFACE of MATTER.

A philosopher by the name of EMPEDOCLES proposed that matter was made of FOUR ELEMENTS:

- EARTH
- WATER
- AIR
- FIRE

He thought that if you MIXED these elements together in DIFFERENT AMOUNTS, you would make DIFFERENT SUBSTANCES.
A bit of history...

Consider wood:

• When you burn wood you see **FIRE**.
• When you leave wood alone it **DRIES OUT**, so there must be **WATER** present.
• **AFTER** it is **BURNED**, **ASHES** are left (**EARTH**).
• While it burns, **SMOKE** is released (**AIR**)
A bit of history...

400 B.C.

Democritus

- Suggested that **MATTER** was made up of tiny **PARTICLES**, which couldn’t be **BROKEN DOWN** any farther.
- He called these particles **ATOMS**, from the Greek word **ATMOS** meaning **INDIVISIBLE**.
- He also thought that **DIFFERENT TYPES** of **MATTER** were made of **DIFFERENT KINDS** of **ATOMS**.

At the time, **DEMOCRITUS’** idea was not accepted because **SOCRATES** didn’t believe it was true.
A bit of history...

**Aristotle (350 B.C)**

- Aristotle was a very well respected scholar and philosopher who organized much of the scientific knowledge at the time.
- He believed **EMPEDOCLES’** theory about the **FOUR ELEMENTS**, and because he had such an **INFLUENCE**, this model, and many other theories were accepted for about **2000 YEARS**.

Aristotle also came up with a theory called **TRANSMUTATION**:

\[ \rightarrow \text{One form of matter could be turned into another.} \]

This was particularly exciting to the Greeks, since if it were true you could turn something **WORTHLESS** (say **LEAD**) into **GOLD**.

This paved the way for the **ALCHEMISTS**.
A bit of history...

The Alchemists (500-1600 B.C.)

• The Alchemists were the first people to perform experiments.

They had 3 main goals:

• Change base metals (tin, lead) into valuable gold.
• Find the substance for eternal life.
• Produce a universal solvent to dissolve all substances.
A bit of history...

None of their goals were ever reached, but the Alchemists are important for many reasons:

- *discovered many elements and their properties, and created chemical symbols for them.*

- *invented many lab tools that we still use today. (beakers, filters, distillation apparatus, etc.)*

- *actually performed experiments.*
Modern Chemists...

Sir Frances Bacon (1561-1626)

- New knowledge must be based on experimentation, and not speculation
- Experiments must be repeatable.

Robert Boyle (1627-1691)

- Did not believe the four-element theory.
- Showed that substances could be mixed to form compounds
Modern Chemists...

Joseph Priestly (late 1700’s)
- Was the first person to isolate oxygen scientifically

Antoine Lavoisier (1743-1794)
- Discovered over 23 different elements
- Determined air is made of oxygen and other gases.
- Was guillotined in the reign of terror
Modern Chemists...

Today:

- An **ELEMENT** is:

  *a pure substance that cannot chemically be broken down into simpler substances.*

Ex) **WATER** can be broken down into **HYDROGEN** and **OXYGEN**, which are **ELEMENTS** that **CANNOT** be broken down any further.
# History of matter timeline:

Use your notes to put the events in the order that they occurred.

<table>
<thead>
<tr>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boyle shows substances can combine to form compounds</td>
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<tr>
<td>Alchemists try to turn cheap metals into gold</td>
</tr>
<tr>
<td>Aristotle suggests the theory of transmutation</td>
</tr>
<tr>
<td>Bacon says we must do experiments</td>
</tr>
<tr>
<td>Lavoisier identifies 23 different elements</td>
</tr>
<tr>
<td>Boyle doesn’t believe the 4-element theory</td>
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History of matter timeline:

Answer Key:

<table>
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<tr>
<td>Empedocles says everything is made of only 4-elements</td>
<td>Boyle doesn’t believe the 4-element theory</td>
</tr>
<tr>
<td>Democritus comes up with the idea of the atom</td>
<td>Boyle shows substances can combine to form compounds</td>
</tr>
<tr>
<td>Aristotle supports the 4-element theory</td>
<td>Priestly discovers oxygen</td>
</tr>
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