

Matter & Energy Unit

Week 1 – What happens
when something burns?



Waterford Biology

1

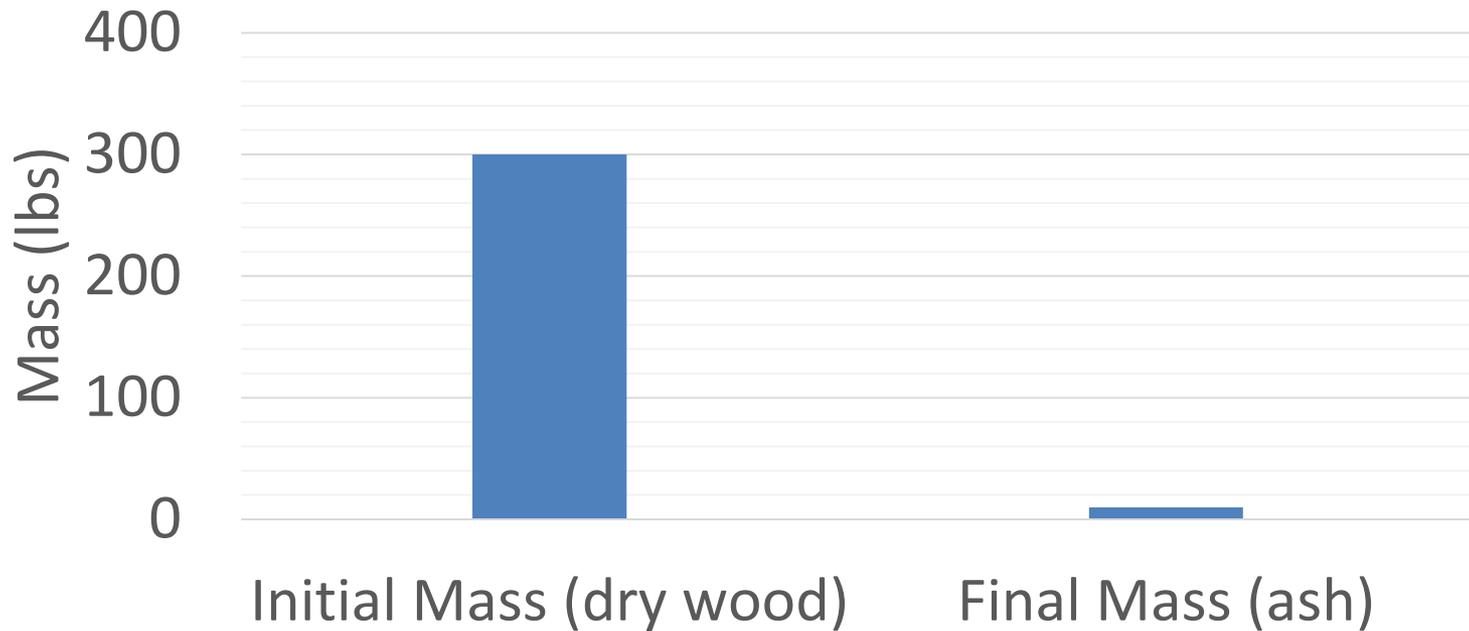
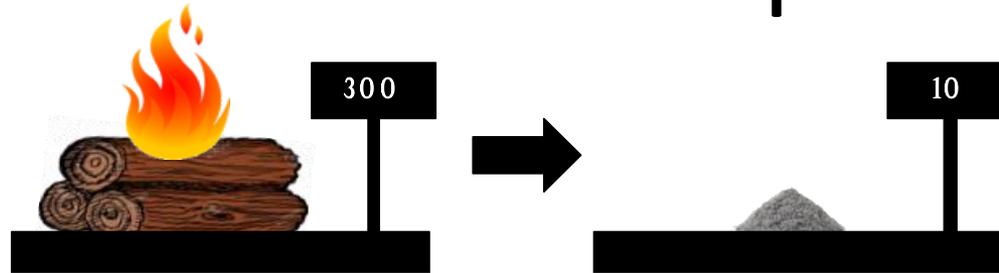
M&E Unit – W1 Driving Question

- This week's driving question: What happens when something burns?
 - What happens to matter during combustion?
 - What happens to energy during combustion?
 - How are matter & energy different from each other?



Source: <https://pxhere.com/en/photo/1604625>

Part 1 Recap



- What claims can we make based on the data above?
- Did the wood disappear into "thin air"?

Does air have mass?



Is it empty?

OR

Is it full?

Zoom into Air

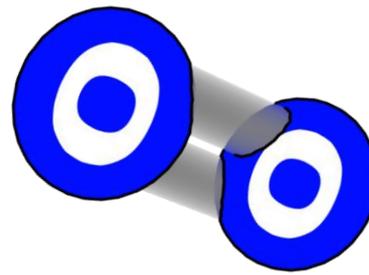
Benchmark Scale	Power of Ten	Decimal Style
Large scale	Larger	Larger
	10^5	100,000
	10^4	10,000
Macroscopic	10^3	1,000
	10^2	100
	10^1	10
	10^0	1 meter
	10^{-1}	0.1
	10^{-2}	0.01
Microscopic	10^{-3}	0.001
	10^{-4}	0.0001
	10^{-5}	0.00001
	10^{-6}	0.000001
Atomic-molecular	10^{-7}	0.0000001
	10^{-8}	0.00000001
	10^{-9}	0.000000001
	Smaller	Smaller



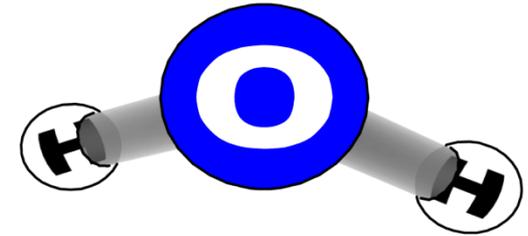
Scale: 10^3 meters = 1000 meters

Different kinds of molecules in air

Benchmark Scale	Power of Ten	Decimal Style
Large scale	Larger 10^5 10^4 10^3	Larger 100,000 10,000 1,000
Macroscopic	10^2 10^1 10^0 10^{-1} 10^{-2} 10^{-3}	100 10 1 meter 0.1 0.01 0.001
Microscopic	10^{-4} 10^{-5} 10^{-6} 10^{-7}	0.0001 0.00001 0.000001 0.0000001
Atomic-molecular	10^{-8} 10^{-9} Smaller	0.00000001 0.000000001 Smaller



Oxygen
 O_2



Water
 H_2O



Carbon dioxide
 CO_2

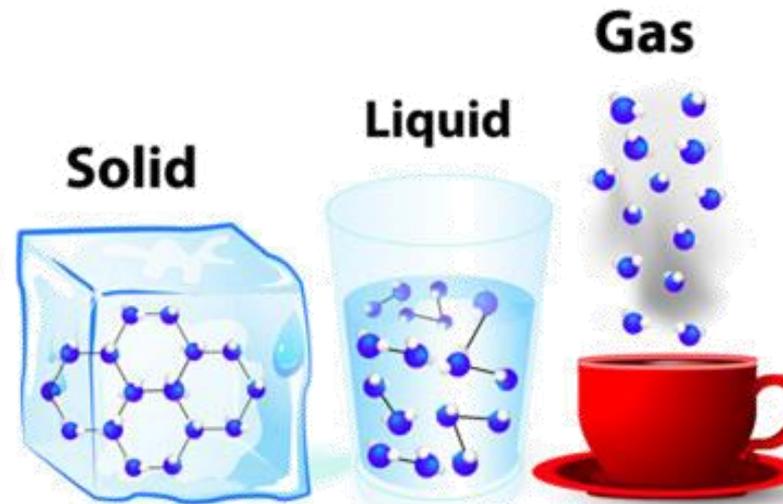


Nitrogen
 N_2

Atomic-molecular Scale

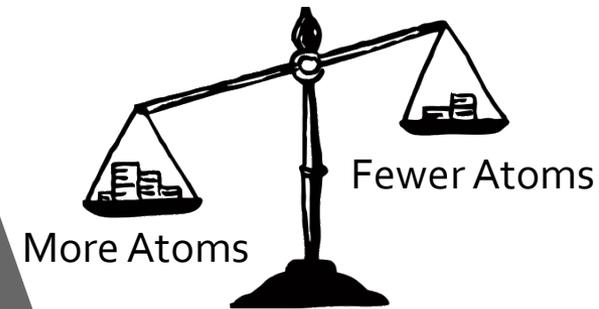
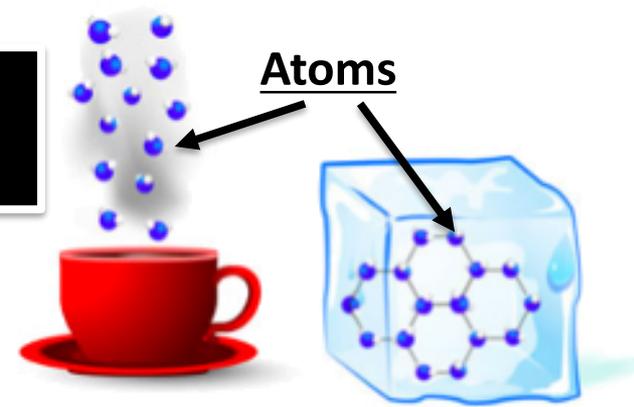
Matter & Energy

- **Everything that exists is either matter or energy.**
 - In biology, matter and energy are always two separate things.
 - Matter does not become energy. Energy cannot become matter.
 - Matter stays as matter. Energy stays as energy.
- **Matter and energy cannot be created or destroyed.**
 - The amount of matter and energy in the universe always stays the same.
- **Matter is all the “stuff” that exists.**
 - Matter consists of physical substances that take up space.
 - In biology, there are three kinds of matter: solids, liquids, and gases.



Matter is made of atoms

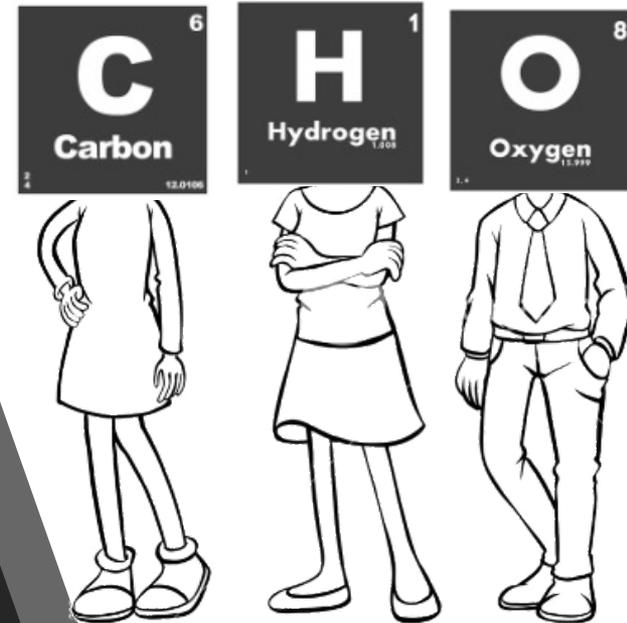
- All matter is comprised of atoms.
 - All solids, liquids, and gases are made of particles of matter called atoms.
 - If you can touch it, it is made of atoms.
- The more atoms something has, the more mass that it has (i.e., *the more it weighs*).
 - For example, as your body grows larger, it gains more atoms.
 - The more atoms in your body, the more you will weigh more on a scale.
- Atoms last forever.
 - In biology, an atom never stops existing.
 - Atoms can only be moved; they cannot be created or destroyed.



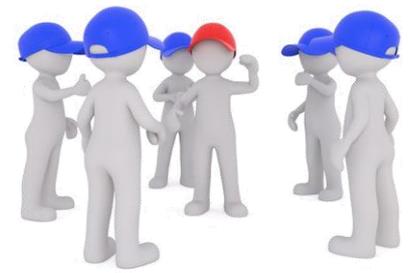
FOREVER ~~Atoms~~
Atoms

Elements = “kinds” of atoms

- Different kinds of atoms are called elements.
 - Carbon, oxygen, and hydrogen are all examples of elements.
- In biology, each atom always exists as the same element.
 - A carbon atom is always a carbon atom.
 - A hydrogen atom cannot become an oxygen atom.
 - Just like you will never become one of your friends (you will always be you), a carbon atom will always be a carbon atom.



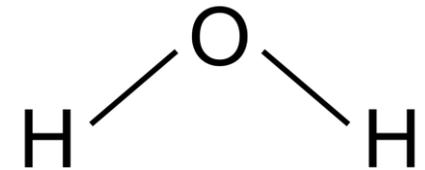
Molecules = Groups of Atoms



A group of students = a class.

- **Atoms can bond to each other to form molecules.**

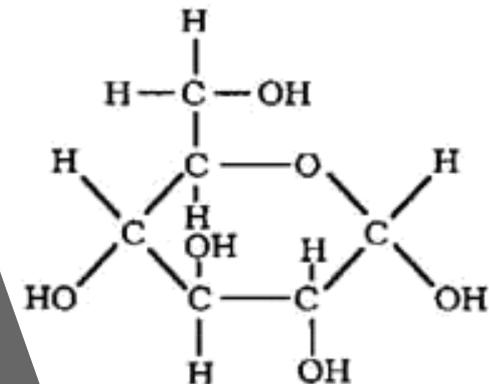
- Just like individual students can be a part of a *class*, individual atoms can be a part of *molecules*.
- For example, water is a molecule that consists of two hydrogen atoms bonded to an oxygen atom.



A group of bonded atoms = a molecule.

- **Atoms can be rearranged to form new molecules.**

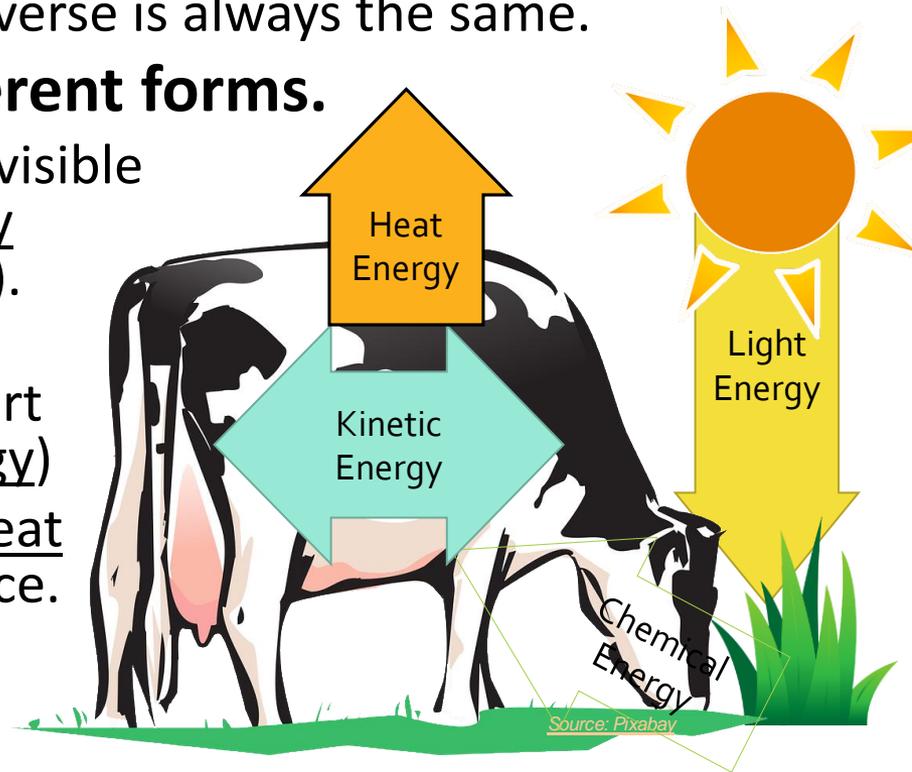
- For example, the atoms in a sugar molecule (*right*) were originally found in water (H₂O) and carbon dioxide (CO₂) molecules.



Atoms from water and carbon dioxide can be rearranged to make sugar.

Energy = changing matter

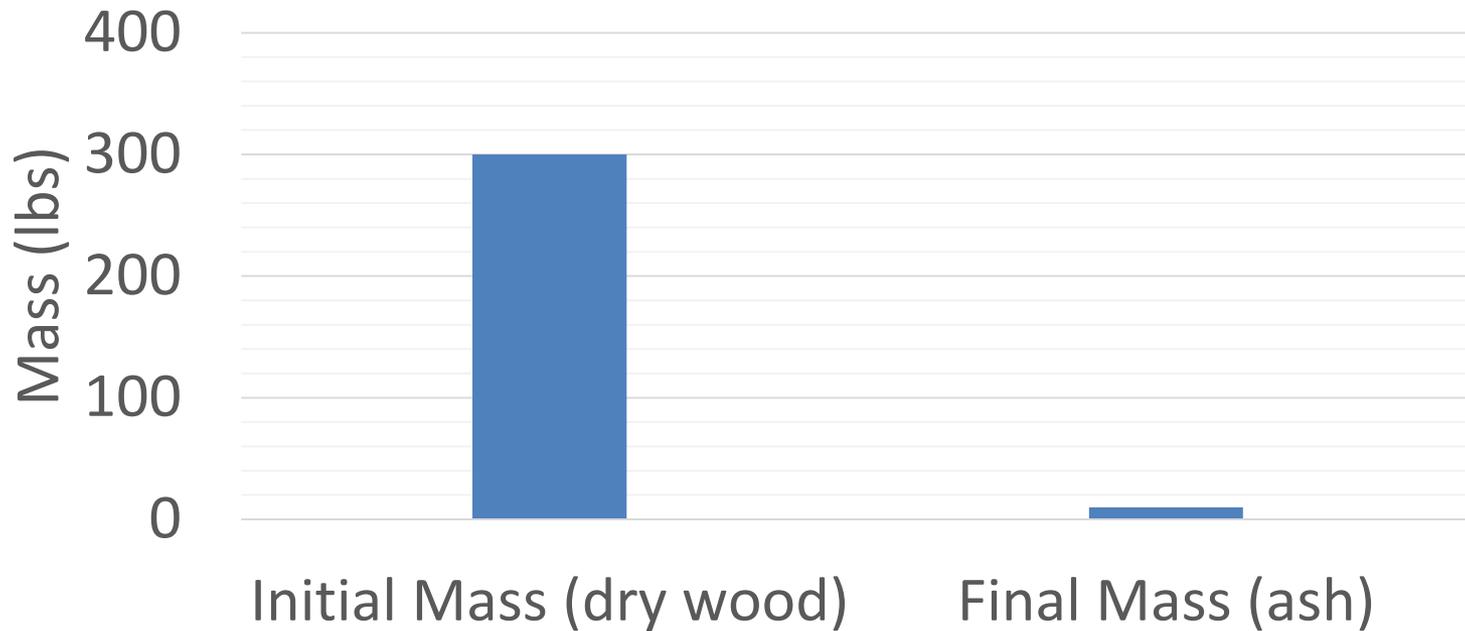
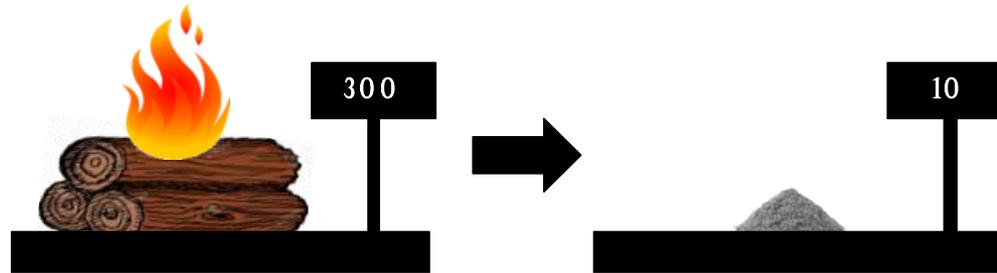
- **Energy is how matter (the “stuff”) changes.**
 - For example, matter can be moved or change temperature.
- **Like matter, energy can neither be created or destroyed.**
 - Energy cannot cease to exist. Energy can only change.
 - The amount of energy in the universe is always the same.
- **Energy can change into 4 different forms.**
 - For example, plants can convert visible light energy into chemical energy (energy stored within molecules).
 - If a cow consumes the chemical energy in that plant, it can convert this into motion (or kinetic energy)
 - Eventually all energy becomes heat energy which dissipates into space.



Recap: The “rules” of matter & energy

- **1) All solids, liquids, and gases are made of tiny particles called atoms.**
 - Atoms can bond together to form molecules.
 - These same atoms can be rearranged to form new molecules.
- **2) In biology, atoms last forever. Atoms cannot be created or destroyed.**
 - Atoms cannot change (e.g., carbon atoms are always carbon atoms).
 - If something gains mass, it gains atoms. If it loses mass, it loses atoms.
- **3) In biology, energy lasts forever. Energy cannot be created or destroyed.**
 - Energy can exist as light, heat, motion, or as chemical energy stored in the bonds of molecules.
 - Energy in one form can be transferred into a different form (e.g., light energy can be transformed into heat energy).

Part 1 Revision



- Can we now improve our claims about the data above?