

WE ARE ALL MADE OF STARS

Where did the materials that make us up
come from?

Learning Objectives

- To learn about astrochemistry and different elements in our universe
- To learn how stars are formed and create a storyboard

Discussion

What are you made of? What am I made of?

Discussion

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What is this table made of?

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What are you made of? What am I made of?

What is this table made of?

All matter on earth, and out in space, is made of chemicals.

Chemicals: Elements and Atoms

An **element** is a substance that cannot be broken down into smaller chemical parts. It contains only **atoms** of one type.

Atoms are the name for the smallest chemical building blocks of all matter in the universe.

What elements have you heard of?

What elements have you heard of?

- Hydrogen
- Helium (in balloons)
- Carbon (in our bodies, and plants, and diamonds)
- Oxygen (that we breathe)
- Calcium (in our bones and teeth)
- Iron (in metal tools)
- Chlorine (in our swimming pools)

Chemicals:

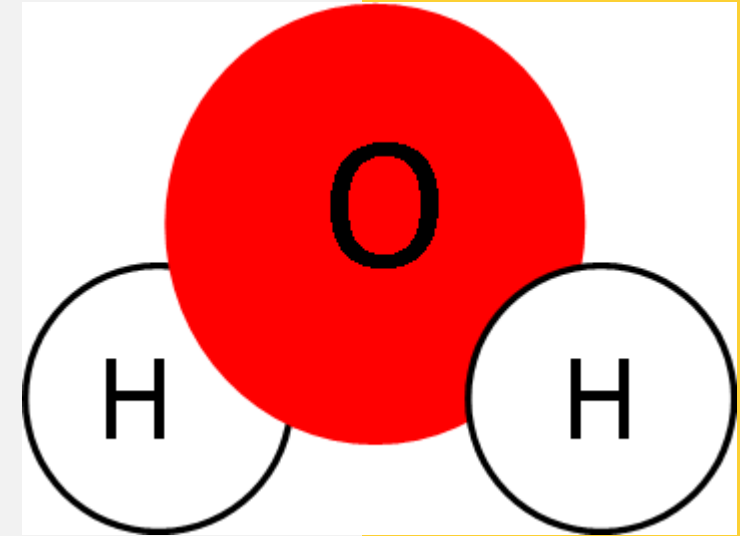
Atoms and Molecules

Atoms of particular elements can join together to make **molecules** – like water (H_2O) and carbon dioxide (CO_2)

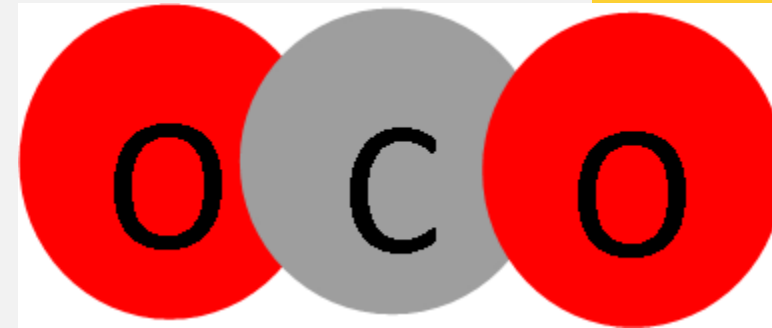
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Water - H_2O



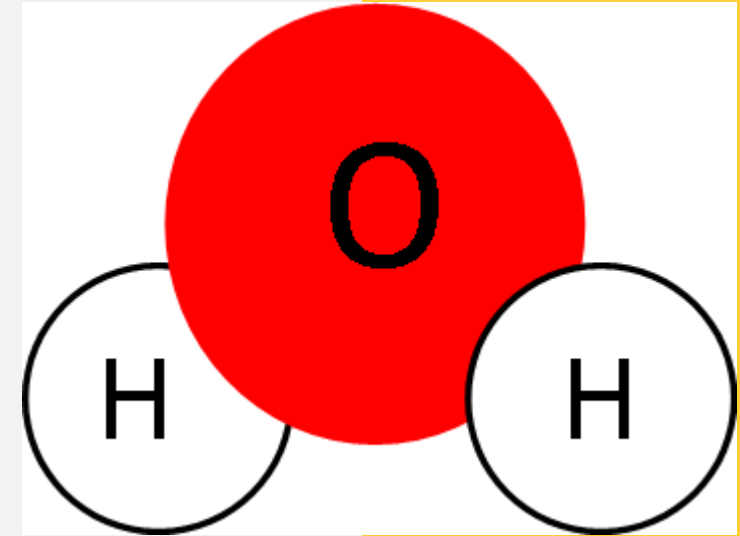
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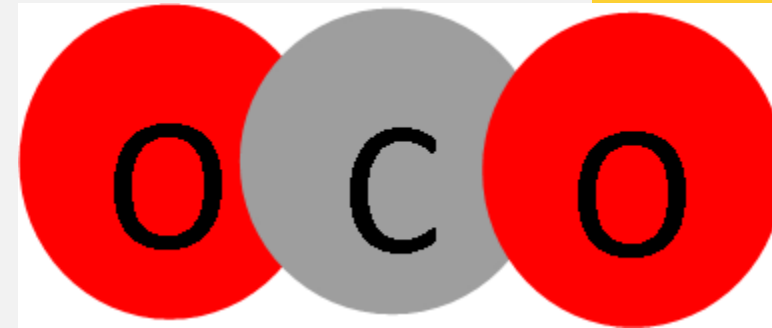
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We – and everything we see around us on earth – and the planets and stars in the universe – are made of atoms and molecules.



Water - H_2O



Carbon dioxide - CO_2

The early universe – after the Big Bang

Three elements were formed within the **first minutes** after the Big Bang.

- Hydrogen
- Helium
- (Tiny amounts of) Lithium

For millions of years no other elements existed.

Today we know of **90 naturally occurring chemical elements**, and scientists have even **created 26 new elements** that did not previously exist.

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PERIODIC TABLE OF ELEMENTS

Chemical Group Block

The image shows a standard periodic table of elements. A callout box highlights Chlorine (Cl) with the following information:

Atomic Number	17	35.45	Atomic Mass, u
Name	Chlorine		
Symbol	Cl		
Chemical Group Block	Halogens		

The periodic table itself includes element symbols, atomic numbers, and names. The callout box is positioned over the Chlorine element in the table.

Image credit *PubChem*

How did we get from a universe of mostly hydrogen, to the world we know today?

150-200 Million years after the big bang, the earliest stars began to form.

Very large clouds of hydrogen, helium and lithium were pulled together by gravity, forming the first stars.

Stars are so hot and dense that they can “fuse” atoms together to form **new types** of elements, in a process called “**nuclear fusion**”.

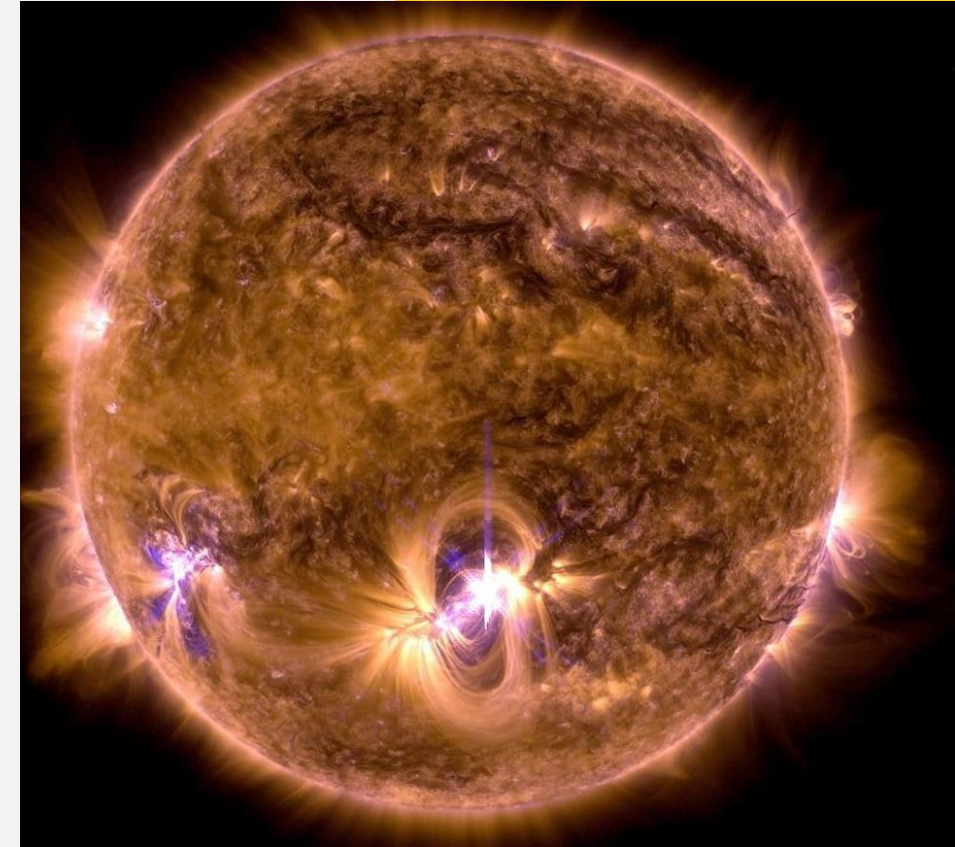
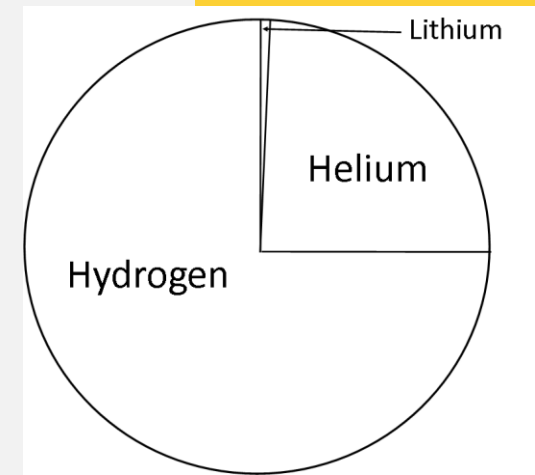


Image credit NASA

Nuclear Fusion

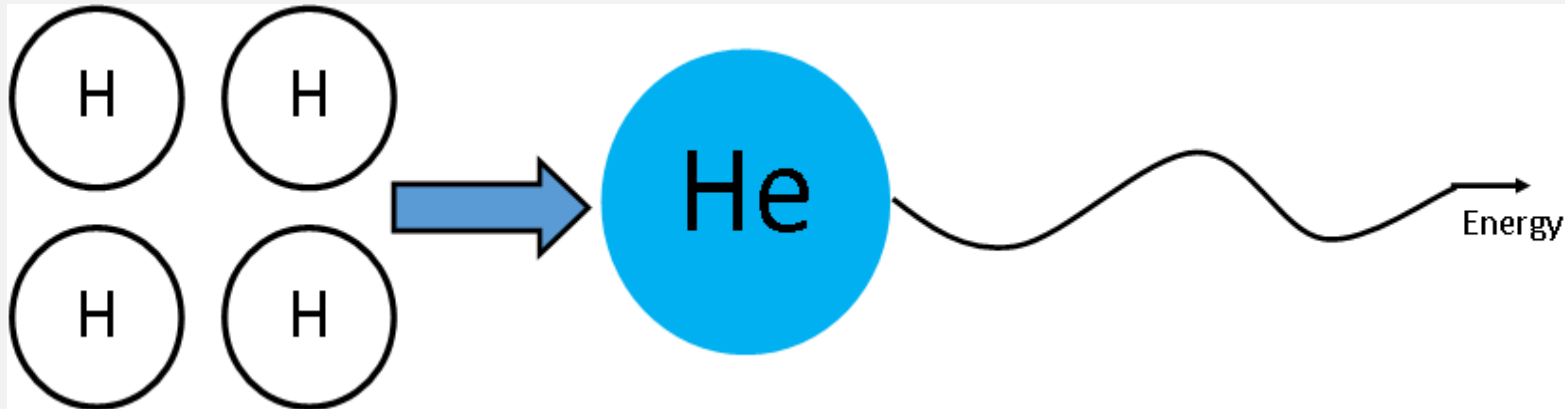
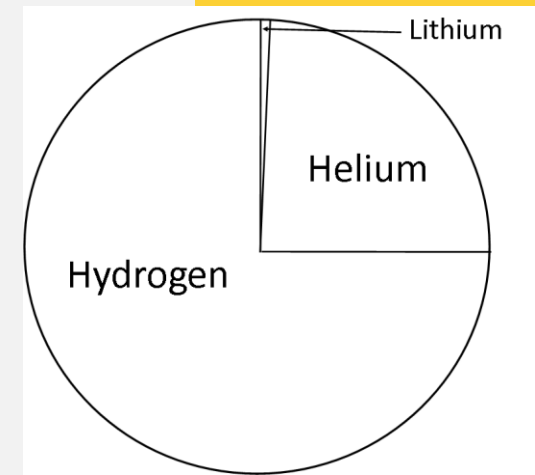
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Nuclear Fusion

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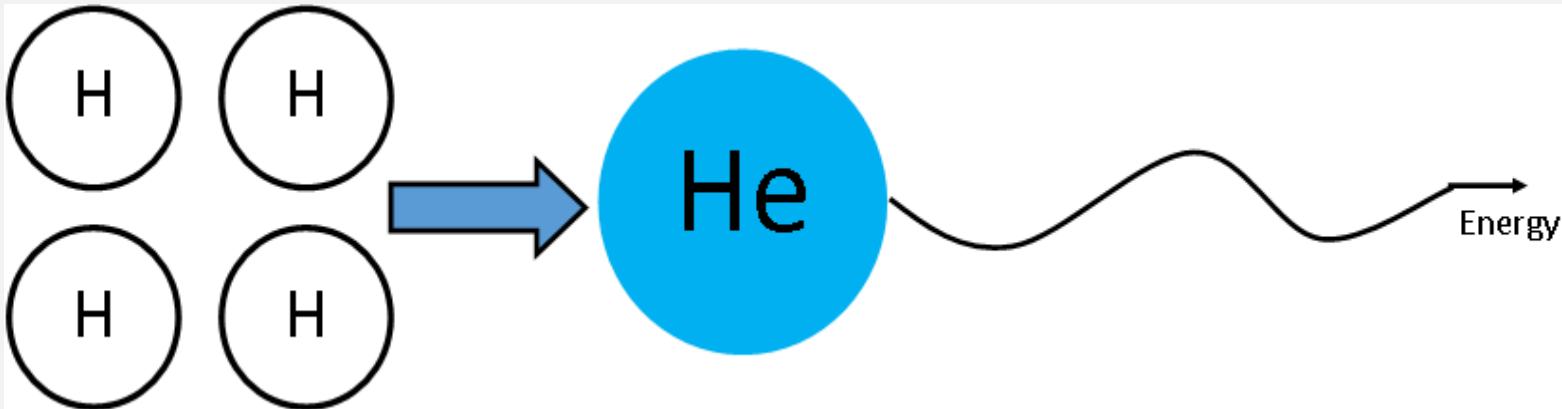
Inside these stars, under huge pressure, hydrogen atoms fused together to make helium atoms.



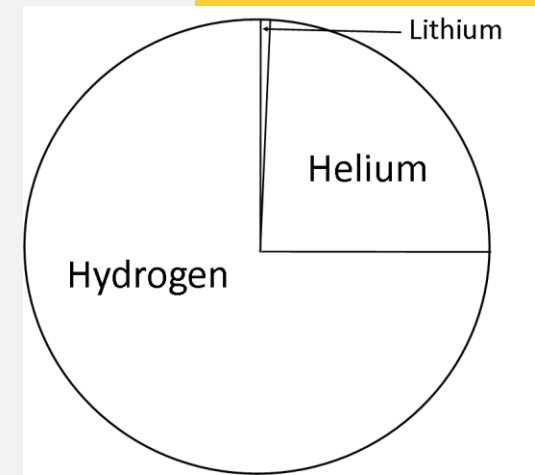
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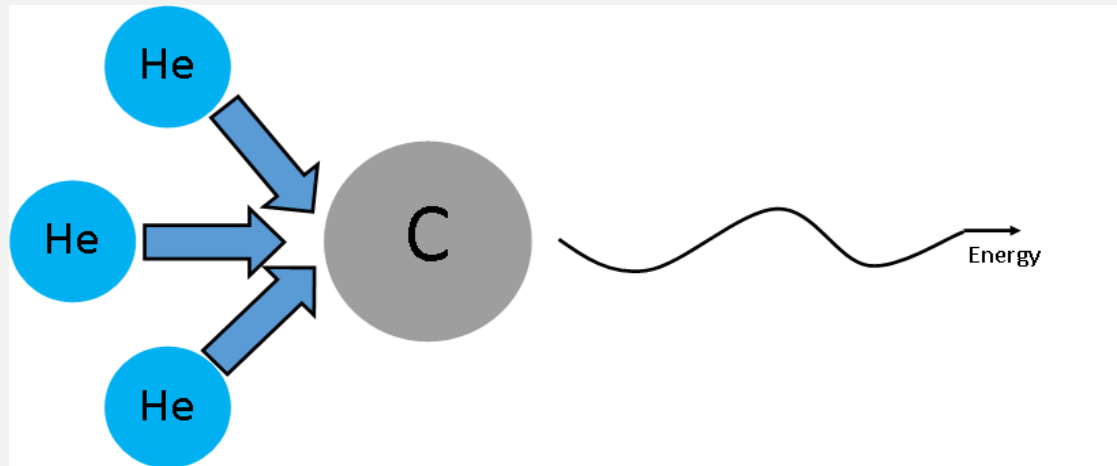


Within a star, this happens **100,000,000,000,000,000,000,000,000,000,000,000 times** a second, making huge amounts of energy as light and heat.



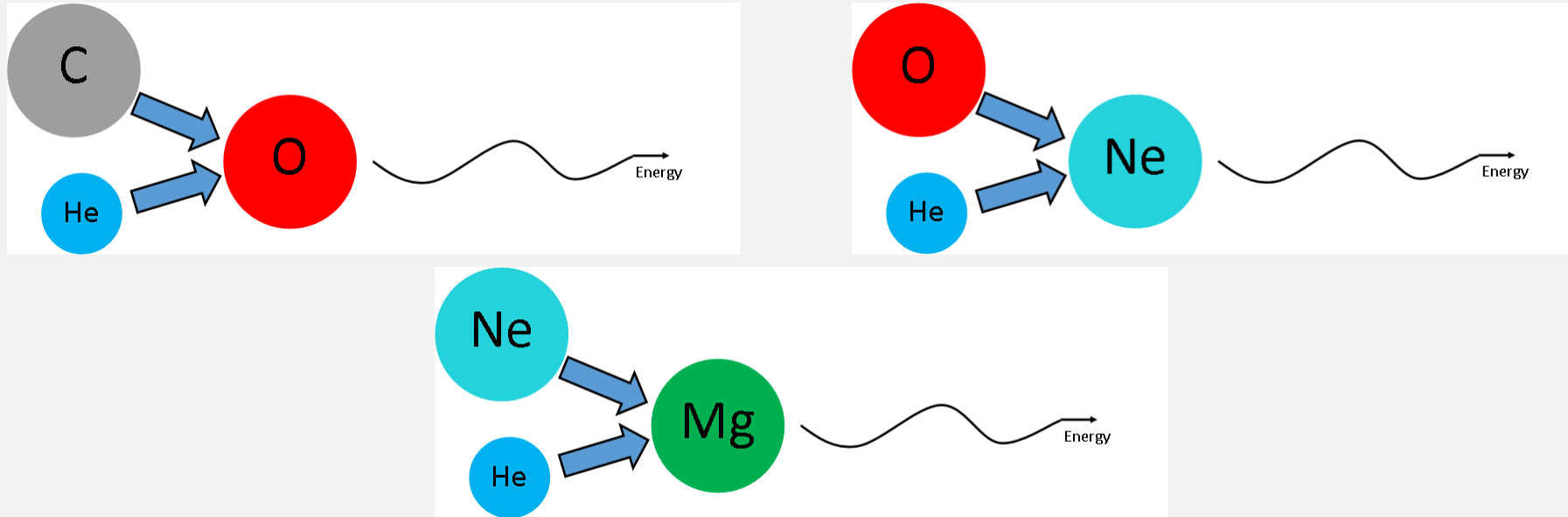
Nuclear Fusion

When stars have run out of Hydrogen in their core, they will start to fuse Helium atoms, to form Carbon.



Nuclear Fusion

The heaviest stars are hot enough that they can continue to fuse together Carbon and Helium in their cores to make other, heavier elements.



This can continue until iron is made. Iron is the heaviest element that is made by nuclear fusion within a star. Once a star has started making iron it will run out of fuel within a few days!

Fusion game

How did these elements get out of the hearts of stars?

Once larger stars have exhausted their fuel, they will collapse and cause a massive explosion, called a supernova.

Huge amounts of energy are released, which allows even heavier elements to form, such as gold.

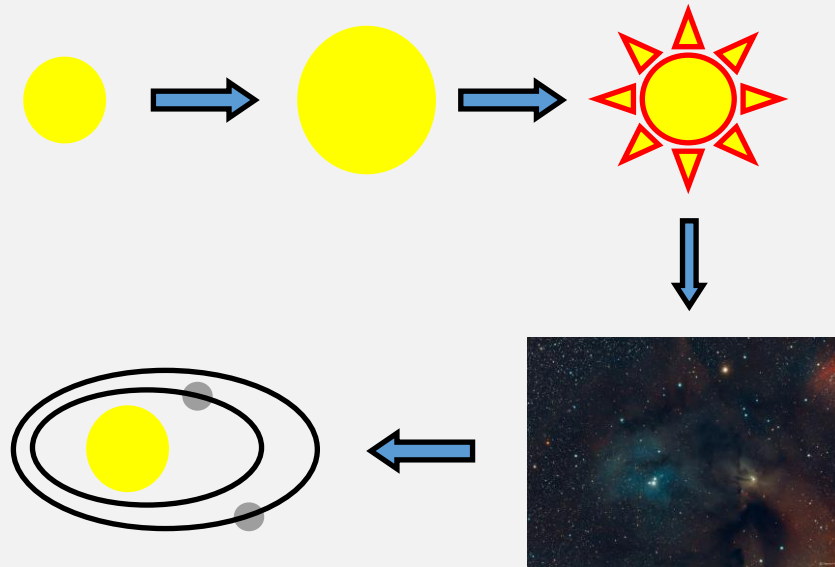
All the elements that were created inside this star will be blown out into a great cloud of dust, called a nebula.



Image credit NASA

And what about us?

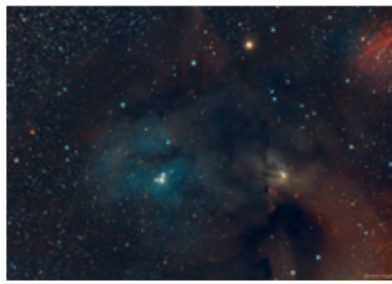
After many millions of years (again), nebulae will collapse again to form one or more new stars, and also planets, made out of the heavier elements created by the first stars.



Our Sun is a **third-generation** star. This process has happened at least twice before our solar system was formed.

Storyboard of the universe

Cut out the shapes from the **next slide/handout**,
and arrange in order



Cloud of H, He and



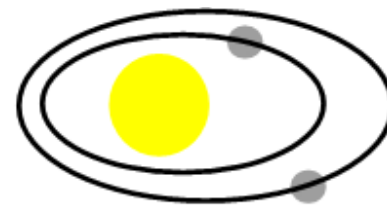
Cloud of dust including new elements



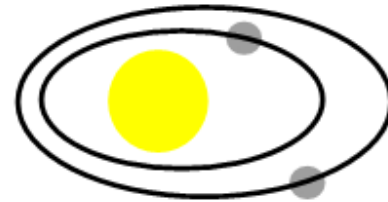
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The Big Bang!

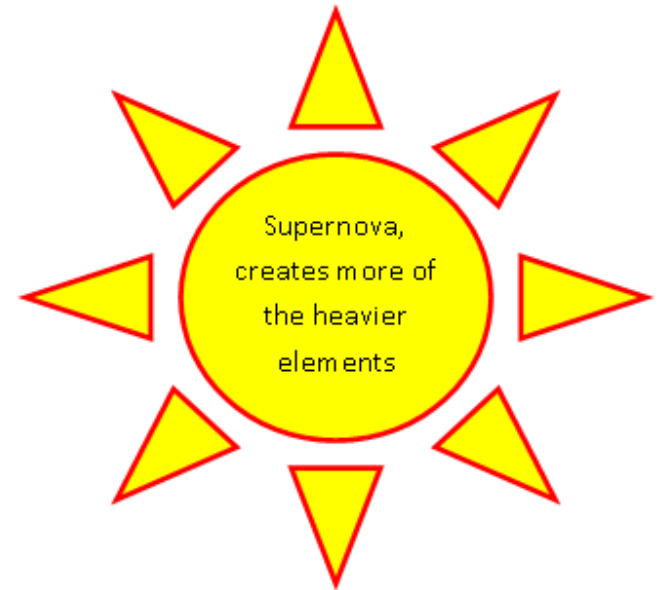
First stars
75% H



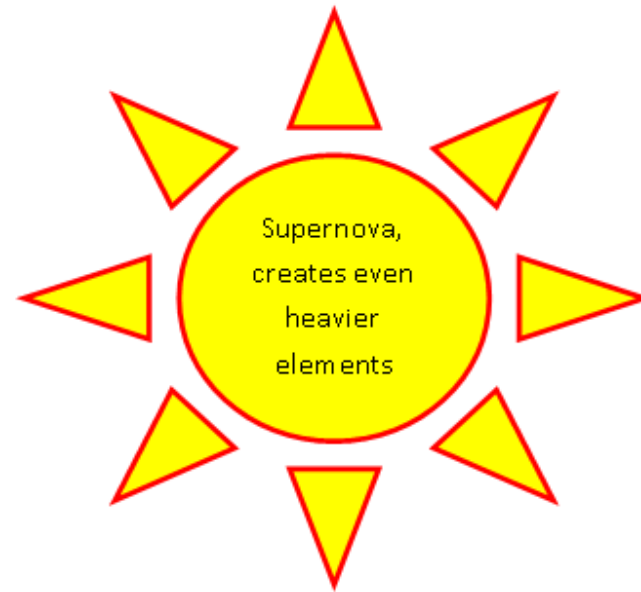
New star with planets



Third generation star with planets



Supernova,
creates more of
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Supernova,
creates even
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The Big Bang!

