



Young Astronomers

Children of the stars

Classroom Activity – After visiting the Observatory

Overview

Age Range:

13-16 years

Lesson Time:

45 min

Cost per activity:

-

Includes the use of:

Computer and Excel, coloured pencils

Outline

Have you ever wondered what your body is made of? Or how much of each element you contain? Use this calculator to find out! Every element you contain that is heavier than hydrogen and helium was created over billions of years during the various developmental stages of stars. So we are made of star stuff!

Pupils will Learn:

- Every human is made up of several elements. It is very likely that you contain material from many different stars that lived a long, long time ago, before our Sun even existed.
- The lightest elements, hydrogen and some of the helium, were created at the same time as the universe, in the Big Bang.
- Most of the mass of humans, which is to say, the rest of the helium along with elements such as carbon, iron and oxygen (meaning iron and elements lighter than iron), were created inside stars over the many years of their calm “middle ages”, ultimately finding their way to us. Elements are mainly created in the nuclear reactions inside stars, but there are a few other processes that can generate them.
- Our bodies also contain elements such as gold (or any element heavier than iron) which are created when stars explode in a supernova at the end of their lives, as well as in certain other processes that have to do with the end of a star’s life-cycle.
- So you are literally made of star stuff, a child of the stars!



Lesson Plan:

Description	Time	Notes
Introduction to the subject	5 min	
Activity 1	30 min	Use the calculator "ChildrenOfTheStars Calculator.xlsx" Use the colouring sheet "ChildrenOfTheStars ColouringSheet.pptx"
Assessment	10 min	

Introduction to the subject:

Pupil prior knowledge

Activate the pupils' prior knowledge and determine their knowledge level by discussing the following questions:

- How many elements can you name? Do you know why they are important for humans? Might one of the pupils know why milk, cheese or spinach are good for you? And what is it that we are breathing?

[Humans are made up of several different elements. Some we have in large amounts, while others (such as gold) only exist in the human body as traces. Pupils may remember that there is iron in their blood and calcium in their teeth. We need to constantly replenish some of these elements in our bodies. We also need water, which is made up of hydrogen and oxygen. So we must have these substances in our bodies as well. We breathe air which is largely nitrogen (the air we breathe actually contains much less oxygen than it does nitrogen).]

Elements are created in stars

The space between the stars is not completely empty. It contains clouds made up of gas and dust. These interstellar clouds are mostly made up of the lightest substances in the universe: hydrogen and helium. All hydrogen and some of the helium was created in the Big Bang, so they are the most ancient substances in existence.

New stars are made when an interstellar cloud starts to condense and collapse in on itself – like somebody making a giant snowball! Stars are like factories that generate huge amounts of heat and many different kinds of light along with new substances, such as carbon, oxygen and iron. (There are a few different ways "middle-aged" stars generate elements, the most

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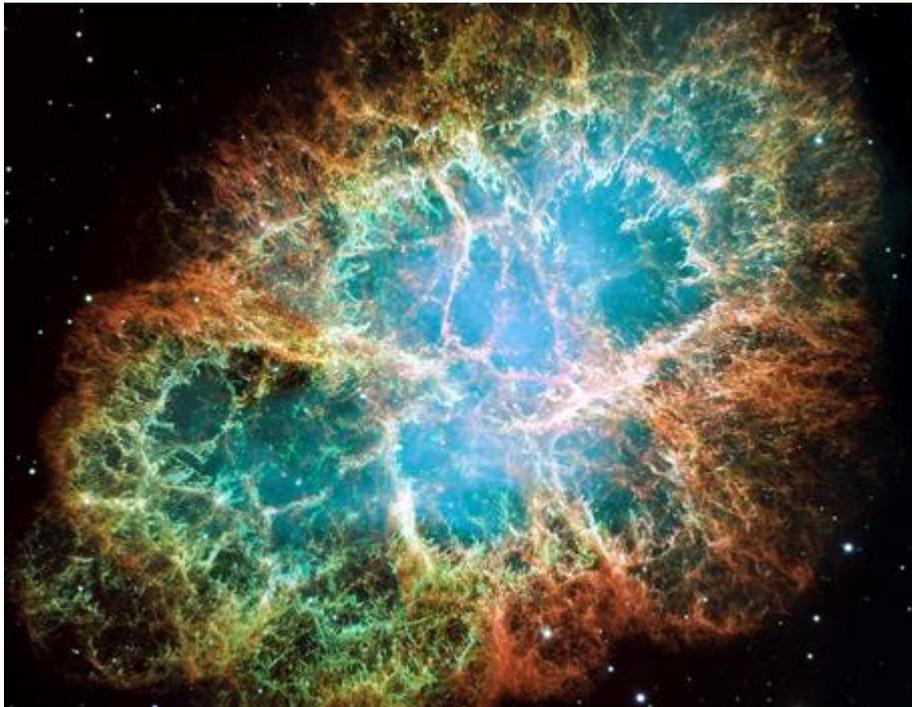
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important of which are the nuclear reactions churning away inside the star.) Stars can generate many different kinds of substances, but they can't do everything. For example, they cannot make gold (or other elements that are heavier than iron). So where did gold and other heavy elements come from?

Gold is created in the intense events that can take place at the end of a star's lifespan, such as supernova explosions. When a star runs out of fuel at the end of its life, it can no longer shine. When this happens, the biggest stars explode as supernovas, scattering all of the matter inside them back into space, to become building blocks for new stars and planets.

So what happens to the substances that are blasted into space in a supernova? They become new interstellar clouds! Our planet Earth, along with the rest of the Solar System, was created from an interstellar cloud which contained elements generated inside long-dead stars. When the matter in the cloud began to collapse in on itself, it created new objects, such as the Earth. This means that you and me contain matter that was made inside stars over billions of years, or created in explosions at the end of a star's lifecycle. We are children of the stars!



The Crab Nebula, one of the most famous supernova explosion remnants. Credit: Public Domain.

Activity 1:

- Download the calculator “ChildrenOfTheStars Calculator.xlsx”.
 - Print out colouring sheets for everyone before the session “ChildrenOfTheStars ColouringSheet.pptx”.
1. Enter your mass into the calculator in kilograms. (We usually talk about our body weight, even though what we mean is our mass.) The calculator will show how much

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of different elements exist in your body (as kilograms and percentages of your total mass). The table will show 16 of the most common elements, but a human body contains up to 59 different elements, some of which in tiny trace amounts. The calculator will also draw graphs of the different elements in kilograms.

2. Compare the results from a few different pupils. [Please note that the percentages of the elements do not vary between individuals.]
3. Illustrate the calculator's results with the colouring sheet. The human in the illustration has been divided into one hundred parts of roughly the same size. Tell the pupils to colour this human in different colours according to the percentage of the various elements in the body. Pupils can choose their own colours for the elements, or use the colours from the graph to represent elements created in different ways. Explain that one percent means one-hundredth of something, or one tiny square in the colouring sheet. The correct amounts can be seen under the "% of mass" column in the calculator. [Please note this means that the solution to the colouring assignment is the same for every pupil.]

Assessment:

- Did you find out which animal or other thing roughly represents the amount of a particular element in your body?
- Were there some elements that you couldn't colour in for the picture of the human? [The amounts of some elements are so small that it's difficult to colour them in this assignment.]
- You have now learned how the Earth was created and where the materials that make a human came from. We can honestly say that we are "star stuff", or the children of the stars. Can you come up with another way of saying this?

Further Activities:

This topic is multidisciplinary and can be used, for example, as an introduction to various phenomena-based learning projects relating to the functions of the human body (in lower-secondary schools).

Background Material/Knowledge:

- Understanding decimals and percentages
- Your mass ("weight")
- If doing this assignment with pupils older than the intended target group, a fundamental understanding of the structure of matter (atoms, elements, etc.) may be useful.