Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

The Solar System

Lesson 6

Stars

Teachers' Notes

Slide 1

Title Slide

Slide 2: "The sun and other stars"

1. In this lesson we will compare the Sun to other stars in our galaxy
2. On a dark night, you can see a faint milky band across the sky. This is the disk of our galaxy, the Milky Way. You are just seeing a higher density of faint stars. The image shows the Milky Way from Chile in the Southern Hemisphere.
3. We will come to the planetary systems around other stars in Lesson 8.

Slide 3: What are stars?

1. Stars are quite simple things – mostly just hydrogen and helium. Those two elements (the simplest in the Periodic Table) make up 98% of stars, and indeed 98% of the whole visible Universe. All the other elements, from carbon right through to Uranium make up only 2% of all stars when you add them **all** together.
2. Ask the pupils this – stars are very massive balls of gas and are trying to collapse under their own gravity. But what keeps them up? What keeps them from collapsing? The answer is on the next slide, but you will have fun asking them this question and seeing what they say.
3. There is an opportunity for a quick activity here. Put them into groups and ask what keeps the Sun and other stars from collapsing and keeps them hot. The answers are on the next slide.

Slide 4: What are stars? (continued)

1. The answer to the question is that stars are giant nuclear reactors and these reactions produce energy. The energy heats the core of the star and that produces a pressure that stops gravity from collapsing the star.
2. What are these nuclear reactions?
3. At the high temperatures and pressures in the centres of stars 4 hydrogen atoms can merge together and create a helium nucleus. This releases energy and we call this process "nuclear fusion"
4. Each reaction produces a tiny amount of energy, but because the sun is so big, it
5. Nuclear reactions only occur in the centre if the star, where it is hottest. They don't occur in the outer regions
6. The surface of the sun is 5500 degrees C. Much less than in the core, so nuclear reactions only happen in the centre.

Slide 5: Our nearest neighbour – the Alpha Centauri system

1. Our sun is a single star. But it is quite common for stars in come in pairs or even in triples. Quite often a pair of stars orbit around each other in what we call a binary system
2. It turns out the nearest "star" to the Sun is actually a triple star system !
3. Alpha Centauri is so called because – it is in the constellation of Centaurus and we use the first letter of the Greek alphabet (alpha) for the brightest star in the that region of sky
4. Alpha centauri is made up of two stars (names given on the slides). In the image, you can't see two stars, they are blended together, but they can easily be seen as two separate stars with a telescope. You can see the zoom in with the Hubble Space telescope on the slide
5. The two stars are similar sizes to the Sun
6. Now weirdly, there is a very faint third star in the system that orbits around the other two. It is a red dwarf, only 7 times the size (by mass) of the sun.
7. It turns out that this faint star is closer to us than the Alpha Centauri double system and we call it Proxima Centauri
8. We will see in Lesson 8 that this star actually has a planet orbiting around it.
9. Proxima Centauri is the closest known star to us at a distance of 4.2 light years away

Show the slide and give out the worksheet.

For gifted and talented pupils:

This is a much more involved estimate of how long it would take to get there. The pupils need to be able to deal with big numbers.

"Lesson6_Distances_to_stars_G&T_pupils.docx"

Full solution sheets are provided.

Slide 7: The Sun

1. Our Sun is a medium sized. There are many larger and smaller stars in the Galaxy.
2. Although only medium sized it is still enormous compared to the size of the earth.
3. The Sun's diameter is 100 times larger than the earth. This means 1 million earths could fit inside the Sun.
4. The Sun will not remain like it is forever. Eventually the hydrogen will all be burned to helium in its core. And the helium will all be burned to carbon. After that the Sun will swell up to become what is known as a red giant. The Sun's radius will increase by more than 100 times. Its atmosphere will cool to about 3000 degrees. But this increase in size would engulf the earth.
5. The Sun is estimated to be about half way through its lifetime and is about 4.5 billion years old. It will take another 4.5 billion years before it becomes a red giant (so nothing to worry about for a while!)

Slide 8: Binary star systems

1. Although our Sun is a single star, and isolated by a long way from the next closest one (Proxima Centuari), binary star systems are very common

2. In fact about half of all stars are in binary systems
3. Less than about 5% are in triples or quadruples.
4. Pupils always think about the famous Tatooine system in Star Wars. We certainly know of close binary systems and it is quite plausible that there are planets around these. In Lesson 8 we will see this.

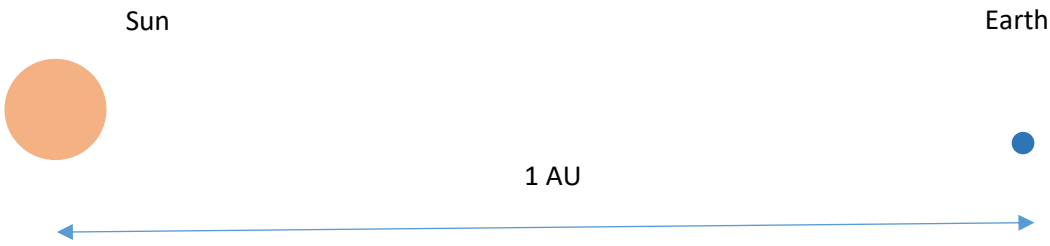
Teachers Evaluation and Handouts

How long would it take to travel to our nearest star?

You saw in the lesson that our nearest star is Proxima Centauri. It is at a distance of 4.2 light years from the earth. Let's work out how long it would take a human made spacecraft to get there.

Remember that this is the **closest** star to us in the galaxy. The galaxy is 10,000 times bigger than that distance. These are very big numbers, let see if we can understand the scale of the distances between stars.

We call the distance between the earth and the Sun "1 Astronomical Unit". It is actually 150,000,000 kilometres ! But let's call it 1 AU (where AU stands for Astronomical Unit)



The solar system is about 130 AU in size – that is 130 AU from the Sun to the edge of the solar system when we reach interstellar space

The space probe Voyager 1 was launched by NASA in 1977 and it took 36 years to reach the edge of the solar system.

Proxima Centauri is 278,000 AU from earth. How long would voyager take to reach Proxima Centauri ?

First work out how long it takes Voyager 1 to travel 1 AU

To travel 1 AU = 36 ÷ 130 = 0.28 years

Now work out how long it takes to travel 278,000 AU

To travel 278,000 = 0.28 x 278,000 = 77,840 years

Do you think humans could ever reach our nearest star?

To get there in a human lifetime (70 years) we would have to send a spacecraft that is 1000 times faster than Voyager 1. That is currently beyond our capability, but perhaps in the future we will be able t