University of Victoria | Science

Science to understand space: Going to the limit to explore the universe, its stars and galaxies

We are travelling on the Earth through space. Space, or our universe, is a big place, way bigger than we can really imagine, and it's busy. Look out on a dark clear night and you'll see millions of stars, some dying and others being born. There are billions of galaxies, or star cities, some that are so distant it takes tens of billions years for their light to reach us in our own galaxy, the Milky Way.

University of Victoria's Sara Ellison is an astronomer who is fascinated with galaxies far, far away. She uses some of the world's newest and biggest telescopes to 'see' out into distant space to try and understand how the first stars and galaxies formed, what they are made of and how the Milky Way, and our solar system, fit into the picture.

Let's see what it's all about - take a trip through the universe on the fastest thing around, light!

What you need

- Your imagination
- A sky map (for example www.skymaps.com/downloads.html)
- Your own eyes or if you can borrow a pair of binoculars so much the better

Activity #1: A 'speed of light' trip through the Universe

It's a big place out there, so to see a lot we need to go fast. The fastest thing in the universe is light – it travels at 299,792 kilometres every second. Light is so fast that it takes only 8 minutes to get from the Sun to us. The same distance by car would take over 170 years, even driving at 100km/hour. Astronomers use a unit called a light year (the distance light travels in a year) to measure distances in space because kilometres are just too tiny – for example 1 light year is 9,460,800,000,000 kilometres – yikes! Let's imagine hopping onto a photon of light from the Sun to surf through the universe! Bring warm clothes—its' cold out there and we could be traveling for a while.

Heading away from Earth on our photons, these are some of the cool things we will see. Make your own travel brochure by finding images of each of these features on the web – there should be good ones for those marked with *.

- **Jupiter***: The largest planet in our solar system. Travel time: 30 minutes.
- **Eris:** At the edge of our solar system. Travel time: about 15 hours. Eris is a dwarf planet. In 2006, the International Astronomical Union defined the difference between a planet and a dwarf planet (in the process demoting Pluto to the latter). See if you can find out what the difference is.
- **Proxima Centauri**: The nearest star to our sun. Travel time: 4 years. Despite being close to us, it is too faint to see with the naked eye. Light from Proxima Centauri reaching Earth today left 4 years ago. What grade were you in when it left?
- **Sirius**: The closest star in our galaxy that we can see without a telescope. It is the 6th nearest overall, but the 5 nearer stars are red dwarfs and very faint. Travel time: 8.6 years.

- **The orion nebula***: This nebula is a stellar (or star) nursery. It's a huge cloud of gas and dust where new stars are being born. Travel time: 1300 years.
- **The cat's eye nebula***: A different kind of nebula, this is what astronomers call a "planetary nebula". It is the final phase in the life of a sun-like star, where the star becomes unstable and as it dies sheds its outer layers. Travel time: 3500 years. The light that we now see from the cat's eye nebula left there at the time of the Stone Age – get your arrowheads ready!
- **The Galactic centre (of the Milky Way)***: We can't see to the centre of our galaxy with our eyes because it's obscured by lots of dust. But using infra-red light, we can 'look' through this dust into the Galactic centre, which is home to 4 million solar masses black hole! See if you can find out how heavy that is in kilograms. Travel time: 27,000 years. Light that reaches Earth today from the centre of the Milky Way left there when most of Canada was covered in ice during the Ice Age. Brrr!
- **Large Magellanic Cloud***: One of the nearest galaxy to our own. Travel time: 150 thousand years.
- **Andromeda galaxy***: The nearest spiral galaxy (like our own Milky Way). Travel time: 2.5 million years.

Most of the galaxies that astronomers study are far more distant than Andromeda, the most distant taking over 13 billion years for their light to get to us. This means that the light left these distant galaxies twice as long ago as the age of our solar system.

You're a star – you made it! Don't forget to come back.

Activity #2: Star-gazing

Choose any dark, clear night and look for some of the features that you visited via photon. Print a copy of a star chart to help you find each feature, and if you can, borrow a pair of binoculars. Look for:

- **Jupiter**: Use binoculars to try to spot the 4 main moons. These were discovered by Galileo over 400 years ago.
- **The orion nebula:** Look for the fuzzy patch that makes up Orion's sword
- **Sirius:** The brightest star in the sky.
- **Andromeda galaxy**: Look in the constellation of Pegasus (towards Cassiopeia).