TEACHER RESOURCE

SCIENCE CONTENT/ CURRICULUM LINK

PLANET EARTH AND BEYOND – ASTRONOMICAL SYSTEMS – EXPLAIN THE NATURE AND LIFE CYCLES OF DIFFERENT TYPES OF STARS IN TERMS OF ENERGY CHANGES AND TIME.

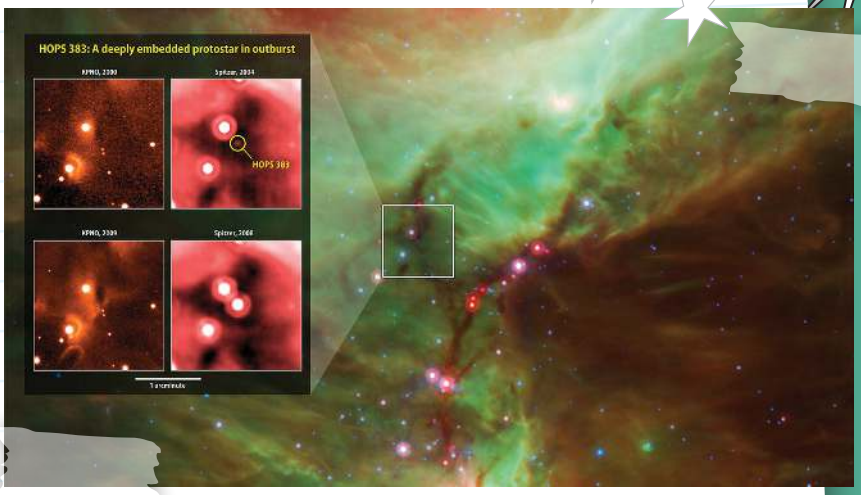
STARDOME OBSERVATORY & PLANETARIUM
FACTS, RESOURCES AND ACTIVITIES ON...

STARS (PART 1 - NEBULAE)

Carl Sagan's quote "We are made of star stuff" is true; we have elements of star material in our bodies. To understand how, we need to know more about stars.

With a telescope and clear night, we can see that some of the "stars" are nebulae. Nebulae are massive clouds of gas, dust, ice, and rock that appear to the naked eye as a single stars because they are so far way. But in reality they are larger than our Solar System by tens of thousands to hundreds of thousands of times.

Astrophysicists determine the chemical composition of nebulae using telescopes fitted with spectrographs. This method led to the discovery that nebulae are mostly made of hydrogen gas. Nebulae have massive amounts of mass, and therefore have huge amounts of gravity pulling it together. When gravity forces parts of the nebulae to collapse into dense spheres the star process begins. With a core at more than 1,500 degrees Celsius, the hydrogen molecules are no longer bound together and become ionized as they whiz around in excited states. We can see the light coming off of these super-heated spheres, and we refer to them as Proto-Stars.



Infrared images from Kitt Peak National Observatory and Spitzer (NASA's space telescope) of a protostar outburst from the Orion nebula. Image credit: NASA/JPL

The next stage is when the sphere is dense enough for the core to reach over one million degrees Celsius. At this temperature the ions and electrons form a plasma of hydrogen "soup", moving together at incredibly high speeds. If the core reaches about 10 million degrees Celsius the repulsion of similarly charged ions is overcome by the strength of the forces which smash them together. This action creates an environment where individual nuclei collide. This process of nuclear fusion results in the creation of helium which then lets off energy radiating outward in the form of photons of light. When the pressure outward balances with the inward pull of gravity, a star is formed.

To see nebulae change into a star would require millions of years of observation. Luckily, there are nebulae in all stages of formation scattered throughout our night sky, and we can see the evolution of these clouds and the stars forming within them. By viewing how similar stars have formed astrophysicists have been able to trace the history of our own Solar System.

It should be noted that when we view the stars in our sky, we aren't seeing them as they currently are, but as they were sometime in the past ranging from minutes ago (our Sun) to thousands of years ago (stars just inside our galaxy).

Light travels at a speed (1 billion km/h), which seems instantaneous over short distances. But from 9.5 trillion km away, it would take light a year to reach us. This is where we get the distance light-year from, the distance it takes light to travel in one year.

Check out these other resources...

- Nebula size comparison: https://www.youtube.com/watch?v=6KjMEVM5QLk
- Spectroscopy: https://en.wikipedia.org/wiki/Spectroscopy
- Star formation: https://en.wikipedia.org/wiki/Star_formation
- Nuclear fusion in Proto-Stars: https://www.e-education.psu.edu/astro801/content/l5_p4.html

DISCUSSION POINT

Breakdown the process of moving from a Nebula, to a Proto-Star, to a Star on the atomic level including protons, neutrons, positrons, gamma rays and neutrinos.

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ACTIVITY

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UNDER THE TELESCOPE

Objective...

To get students to think about:

- The scale of our galaxy
- The astronomical objects that exist in and around our galaxy
- The speed of light and the time it takes light to travel over large distances.

Scenario...

Your students are aliens and they have been assigned to a mission to discover more about the planet Earth.

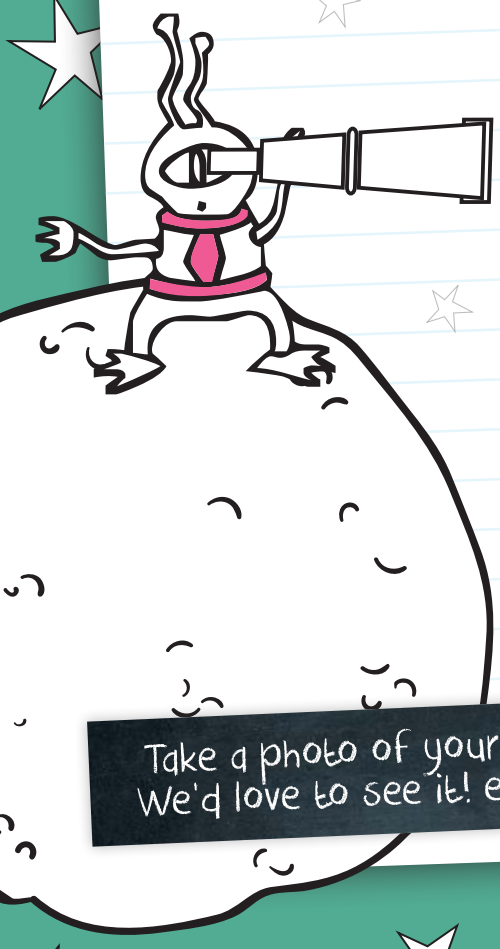
Project...

In groups, ask the students to select a location in our Milky Way or in a neighbouring galaxy.

Ask the students to prepare a mission plan for studying Earth from their chosen location. They should think about the following:

- How technologically advanced are the aliens?
- What equipment will they use to observe Earth?
- What do they expect to discover?
- What environmental elements are on their alien location?
- Can the students calculate how many light-years away Earth is?
- Can they then calculate what the time period on Earth would be?

Students should present their findings, along with a brief outline of their selected location, to the class.



Example...

ALIEN LOCATION: Orion Nebula.

METHOD TO OBSERVE EARTH:
Space Observatory (more advanced than anything humans have created).

DISTANCE FROM EARTH: 1,000 light-years.

AIM: To discover more about transportation on Earth.

DATE ON EARTH: 1016.

DISCOVERIES:
- Observed Medieval Europe.
- Humans used horses for transportation.

Take a photo of your activity and send it to us.
We'd love to see it! education@stardome.org.nz

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