Red Supergiant Star Betelgeuse

Why in News?

The **bright red star Betelgeuse**, known as **'Thiruvathirai' or 'Ardra'** in Indian astronomy, captivates observers with its prominent position in the <u>constellation Orion</u>.

Recent research conducted by Japanese and Swiss researchers has shed light on the star's pulsation patterns.

What is Betelgeuse's Pulsation?

About Betelguese:

- Betelgeuse is a red supergiant star that is nearing the end of its life. It is the second-brightest star in the constellation of Orion, after Rigel.
 - Scientists noticed that **Betelgeuse was mysteriously dimming in late 2019** following a traumatic outburst caused by the star blowing off a large portion of its visible surface.
- Betelgeuse varies in brightness because of two main factors: changes in its surface temperature and changes in its size.

• As a red supergiant, Betelgeuse has a very unstable outer layer that is prone to convection and pulsation.

- The Pulsating Mechanism:
 - The pulsation of Betelgeuse refers to the **periodic contraction and expansion of the star.**
 - Researchers have compared the observed pulsation of Betelgeuse to theoretical estimates, **indicating that the star is in its late carbon-burning stage.**
 - Pulsation periods provide valuable insights into the star's radius, <u>luminosity</u>, and mass, affirming its current phase of core carbon-burning.
 - Similar to a pot's lid lifting to release steam, red giant stars expand and contract due to heating and cooling of hydrogen in their outermost layers.
 - The star's outermost envelope contains cooler neutral hydrogen, which absorbs heat from the interior, causing the star to expand.
 - As the **temperature rises, hydrogen becomes ionised and can absorb more heat,** leading to a forceful expansion and ejection of the outermost shell.
 - The cyclic nature of this process results in **periodic dimming and brightening of the star, observable from a distance.**
- Stages of Evolution:
 - Stars like Betelgeuse fuse hydrogen into helium during their initial stages, which helps maintain a balance between gravity and energy release.
 - Massive stars like Betelgeuse **run out of hydrogen fuel in a few crore years,** when they switch to using helium to make carbon. Helium runs out in about **10 lakh years.**
 - As each stage progresses, the **burning of elements becomes faster, with carbon burning in a few hundred years** and silicon burning in about a day.
 - Afterwards red giants briskly consume one by one the elements of the periodic table, until finally their core brims with iron.
 - Once the core is rich in iron, the temperature and pressure within the star drop. With nothing to stop it, **gravity compresses the core and turns it into a**

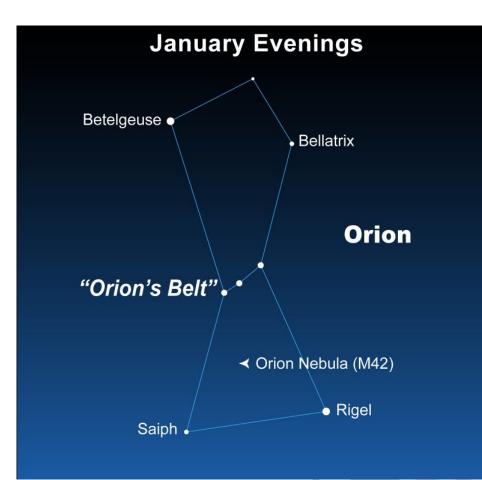
neutron star or a black hole.

• Betelgeuse's late-<u>carbon</u> stage signifies the terminal phase before the star's imminent collapse.



What is the Constellation Orion?

- Constellation:
 - A constellation is an area on the celestial sphere in which a group of visible stars forms a perceived pattern or outline, typically representing an animal, mythological subject, or inanimate object.
 - They are useful in assisting astronomers and navigators to locate certain stars
 Officially, there are 88 recognized constellations in the night sky. These
 - constellations were defined and established by the <u>International Astronomical Union</u> (IAU).
 - IAU was founded in 1919, headquartered in Paris, France.
- Constellation Orion:
 - It is a prominent constellation that can be seen throughout the world.
 - It is located on the celestial equator and is best visible in the evening sky from January to April in the Northern Hemisphere, and from November to February in the Southern Hemisphere.



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