T: 100,000-10,000,000 R: < Radius of Jupiter

Wendy Tran

THE CRAB PULSAR

PSR 0531+21

DISCOVERY

- discovered in **10 November 1968** by **Richard Lovelace** and his team at the **Arecibo Radio Observatory, Puerto Rico**
- remnant of **1054 Supernova** - formed from the **Crab Nebula (6,500 light years** from Earth)
- "a novel type between a white dwarf and neutron star"

PROFILE

Age: ~950 years old
Diameter: 20km
Solar mass: 1.4
Rotations: 30 times each second
Location: the centre of the Crab Nebula

SIGNIFICANCE

- first reported to be observed by **Chinese, Japanese, Korean & Arab** astronomers in 1054 - in the constellation of the **Bull/Taurus**
- "sighting a new bright star in the heavens"
- one of the **very few pulsars** to be observed and studied
- the **brightest** of the known neutron stars - **1,000 times brighter** than the next brightest pulsar (PSR

THE CRAB NEBULA

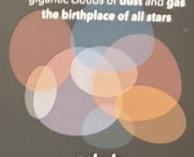
- this image combines data from the **Hubble Telescope** (purple hues), x-ray images from **Chandra X-ray Observatory** (blue/white hues) & **Spitzer Space Telescope** (pink hues)
- **William Parsons** observed the nebula and produced a drawing that looked similar to a crab, thus naming it the **Crab Nebula** and the **Crab Pulsar**

DEATH

- **uncertain fate**
- already considered a '**dead**' star as it is one of the end states of stellar evolution
- the Crab Pulsar, and pulsars in general, will go through phases of **cooling**

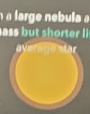
stellar evolution

gigantic clouds of **dust** and **gas** **the birthplace of all stars**



nebula

formed from a **large nebula** and has much **higher mass but shorter life** than an average star



massive star
2-8 solar masses

extremely large and luminous stars with a short life span of ~10-50 million years

blue supergiant
10 - 40 solar masses

after blue supergiants **cool** and **expand**, they can become red supergiants, living for ~10-50 million years

red supergiant
10 - 40 solar masses

large, hot and luminous stars that also have a **short lifespan**

blue giant
> 8 solar masses

the **explosive death** of a star as it **collapses** in upon itself

supernova
in 1054 AD

the result of **supernovae** and composed of **closely packed neutrons**

neutron star

highly magnetised rotating **neutron star** or **white dwarf** - emits beams of **electromagnetic radiation**

pulsar

a region of space having a **gravitational field** so intense no matter/radiation can escape it

black hole

the fusion in the **outer layers** run out of fuel and begin to **float off** into space

planetary nebula

the dense **left over** core of a planetary nebula that will **cool** for **billions of years** to become a **black dwarf**

white dwarf

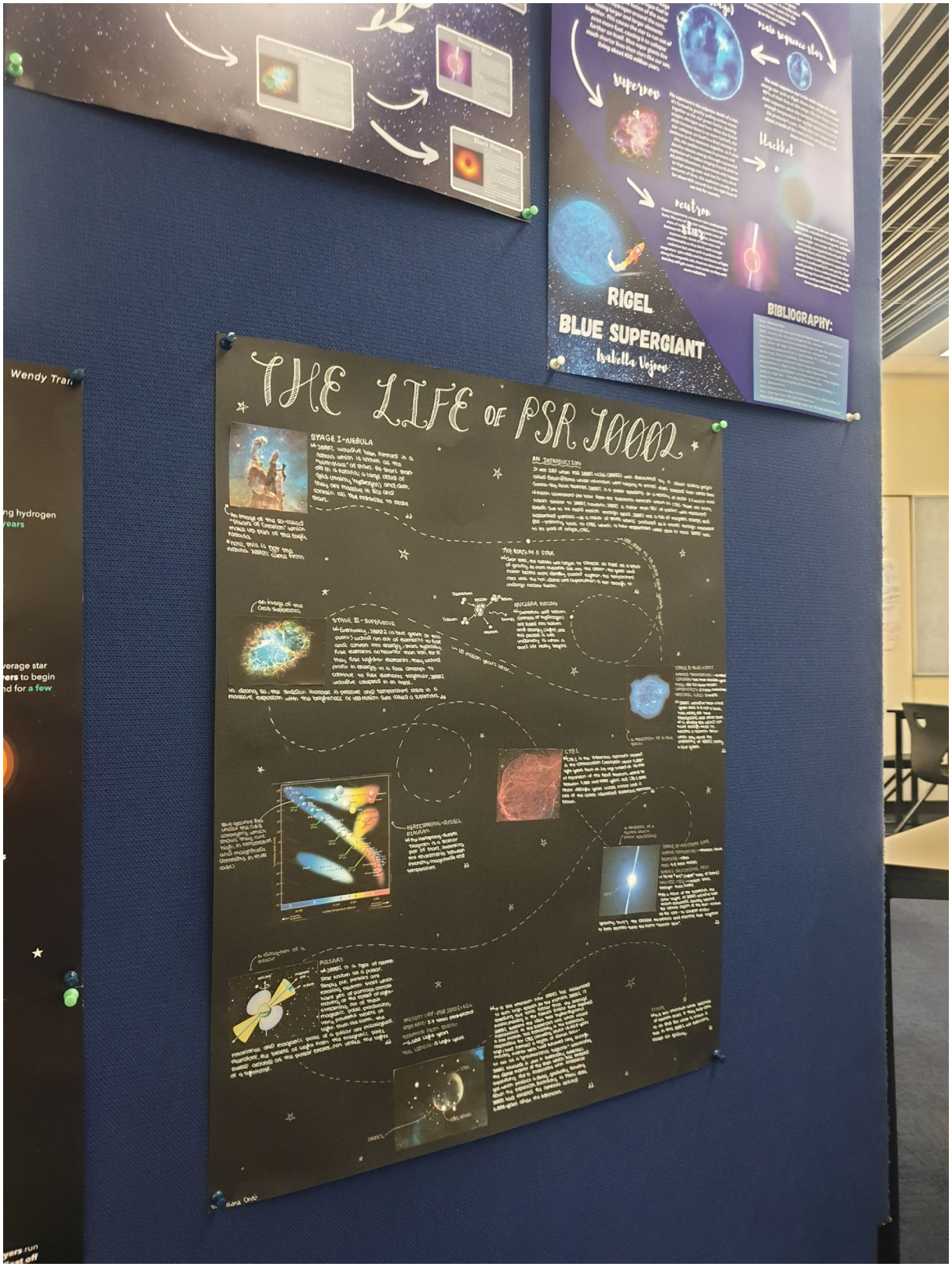
LIFE-CYCLE OF THE CRAB PULSAR

the **most stable star** undergoing hydrogen fusion for ~10 billion years

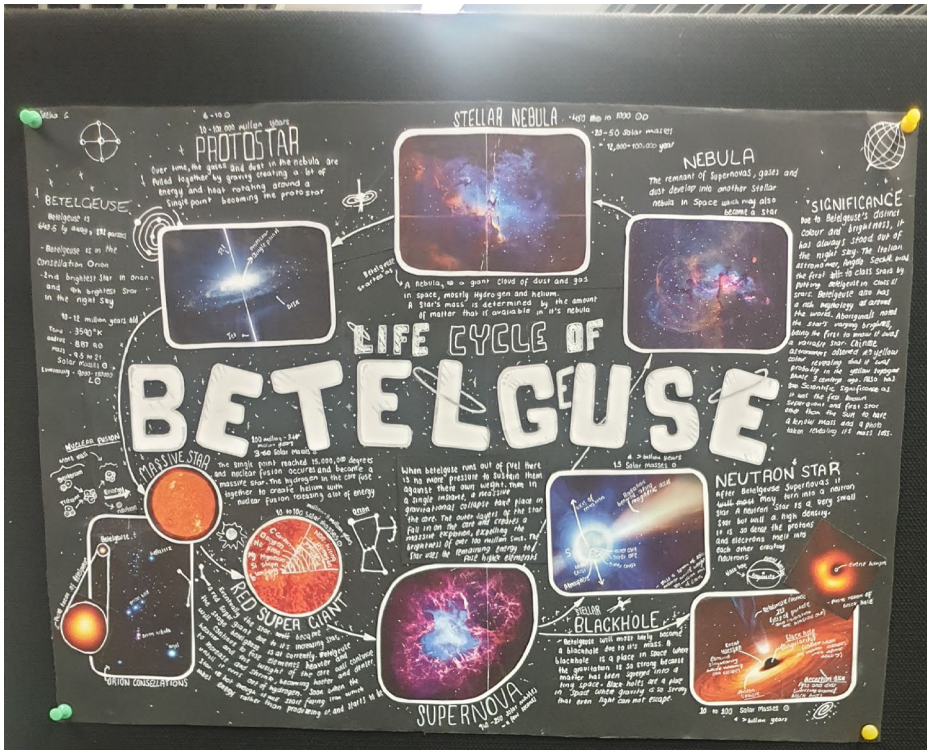
average star

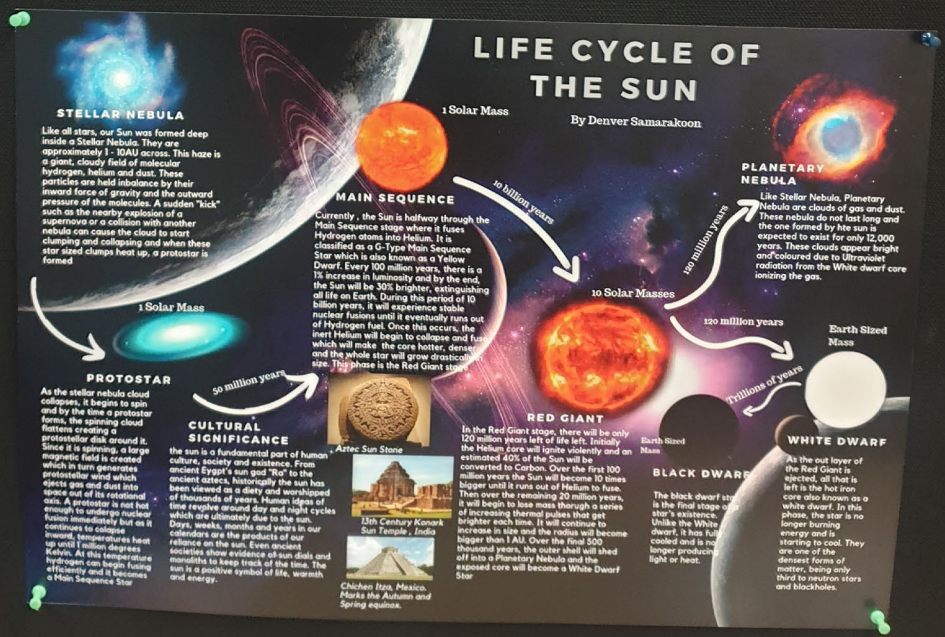
formed when **core** of an average star **collapses,** causing **outer layers** to begin **hydrogen** fusion and expand for a few billion years

red giant
> 8 solar masses


RIGEL
BLUE SUPERGIANT
Isabella Vojeco
BIBLIOGRAPHY:
THE LIFE OF PSR J0002
STAGE I-NEBULA
AN INTRODUCTION
THE BIRTH OF A STAR
STAGE II-SUPERNOVA
NUCLEAR FUSION
CTB1
HERTZSPRUNG-RUSSELL DIAGRAM
PULSARS

12,700 kilometres
93 billion light years
6,000 kilometres
1,700 kilometres
25 kilometres
1.4 million kilometres
100,000 light years
9 billion kilometres
25 micrometers
110 metres


LIFE CYCLE OF
BETELGUSE
STELLAR NEBULA
PROTOSTAR
NEBULA
SIGNIFICANCE
BETELGEUSE
MASSIVE STAR
RED SUPER GIANT
NEUTRON STAR
STELLAR BLACKHOLE
SUPERNOVA
ORION CONSTELLATIONS


LIFE CYCLE OF THE SUN
By Denver Samarakoon
STELLAR NEBULA
Like all stars, our Sun was formed deep inside a Stellar Nebula. They are approximately 1 - 10AU across. This haze is a giant, cloudy field of molecular hydrogen, helium and dust. These particles are held imbalance by their inward force of gravity and the outward pressure of the molecules. A sudden "kick" such as the nearby explosion of a supernova or a collision with another nebula can cause the cloud to start clumping and collapsing and when these star sized clumps heat up, a protostar is formed
1 Solar Mass
PROTOSTAR
As the stellar nebula cloud collapses, it begins to spin and by the time a protostar forms, the spinning cloud flattens creating a protostellar disk around it. Since it is spinning, a large magnetic field is created which in turn generates protostellar wind which ejects gas and dust into space out of its rotational axis. A protostar is not hot enough to undergo nuclear fusion immediately but as it continues to collapse inward, temperatures heat up until 1 million degrees Kelvin. At this temperature hydrogen can begin fusing efficiently and it becomes a Main Sequence Star
50 million years
CULTURAL SIGNIFICANCE
the sun is a fundamental part of human culture, society and existence. From ancient Eygpt's sun god "Ra" to the ancient aztecs, historically the sun has been viewed as a diety and worshipped of thousands of years. Human ideas of time revolve around day and night cycles which are ultimately due to the sun. Days, weeks, months and years in our calendars are the products of our reliance on the sun. Even ancient societies show evidence of sun dials and monuliths to keep track of the time. The sun is a positive symbol of life, warmth and energy.
Aztec Sun Stone
13th Century Konark Sun Temple , India
Chichen Itza, Mexico. Marks the Autumn and Spring equinox.
1 Solar Mass
MAIN SEQUENCE
Currently , the Sun is halfway through the Main Sequence stage where it fuses Hydrogen atoms into Helium. It is classified as a G-Type Main Sequence Star which is also known as a Yellow Dwarf. Every 100 million years, there is a 1% increase in luminosity and by the end, the Sun will be 30% brighter, extinguishing all life on Earth. During this period of 10 billion years, it will experience stable nuclear fusions until it eventually runs out of Hydrogen fuel. Once this occurs, the inert Helium will begin to collapse and fuse which will make the core hotter, denser and the whole star will grow drastically in size. This phase is the Red Giant stage
10 billion years
10 Solar Masses
RED GIANT
In the Red Giant stage, there will be only 120 million years left of life left. Initially the Helium core will ignite violently and an estimated 40% of the Sun will be converted to Carbon. Over the first 100 million years the Sun will become 10 times bigger until it runs out of Helium to fuse. Then over the remaining 20 million years, it will begin to lose mass thorugh a series of increasing thermal pulses that get brighter each time. It will continue to increase in size and the radius will become bigger than 1 AU. Over the final 500 thousand years, the outer shell will shed off into a Planetary Nebula and the exposed core will become a White Dwarf Star
120 million years
PLANETARY NEBULA
Like Stellar Nebula, Planetary Nebula are clouds of gas and dust. These nebula do not last long and the one formed by hte sun is expected to exist for only 12,000 years. These clouds appear bright and coloured due to Ultraviolet radiation from the White dwarf core ionizing the gas.
120 million years
Earth Sized Mass
Trillions of years
Earth Sized Mass
BLACK DWARF
The black dwarf st is the final stage o star's existence. Unlike the White dwarf, it has fu cooled and is no longer producing light or heat.
WHITE DWARF
As the out layer of the Red Giant is ejected, all that is left is the hot iron core also known as a white dwarf. In this phase, the star is no longer burning energy and is starting to cool. They are one of the densest forms of matter, being only third to neutron stars and blackholes.