What It Takes to Be a STAR

More than 100 billion stars exist in our galaxy, yet on a clear night only about 3,000 of them are visible to the naked eye.

STAR BRIGHT

- ★ **A bright star, as seen from Earth, is either closer to us than other stars or produces more energy—or both.**
- ★ **Astronomers rate star brightness by magnitude. Magnitude 1 is about 100 times brighter than magnitude 6.**
- ★ **Stars with a magnitude of 6 or less can be seen with the naked eye.**
- ★ **The brightest star seen from Earth, Sirius, is magnitude –1.46.**

For Good Luck . . .

Make a wish on the first star you see at night:

Star light, star bright,
First star I see tonight,
I wish I may, I wish I might,
Have the wish I wish tonight.

Light from an explosion illuminates dust around the star V838 Moncerotis, 20,000 light-years away from Earth.

ALL STARS ARE NOT WHITE

★ The color of a star indicates the temperature at its surface. The hottest stars are blue. The coolest stars are red. (Think of a candle flame. The hottest area is blue!) Astronomers have sorted star colors into classes. More stars are red than any other color.

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A Rainbow of Stars

CLASS	COLOR	TEMPERATURE	STAR
O	Blue	30,000–60,000 K	Delta Orionis
B	Bluish white	10,000–30,000 K	Rigel
A	White	7,500–10,000 K	Sirius
F	Yellowish white	6,000–7,500 K	Fomalhaut
G	Yellow	5,000–6,000 K	Sun
K	Orange	3,500–5,000 K	Arcturus
M	Red	2,000–3,500 K	Betelgeuse

Star temperature is measured on the KELVIN SCALE:
0 (zero) K = –459.67° Fahrenheit = –273.15° Celsius

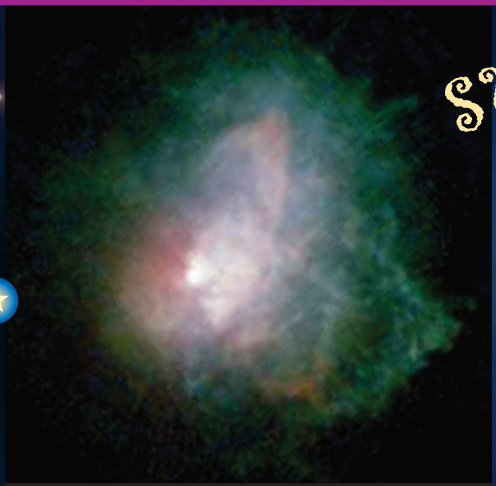
HOW STARS ARE BORN

★ Stars form in dense billows of gas and dust particles called **GIANT MOLECULAR CLOUDS.** Gravity constantly pulls the particles together, while pressure constantly pushes them apart, until the molecular cloud cools. The particles then gather into clumps called **PROTOSTARS.** Gathering creates heat, and some protostars become so hot that they release energy (a process called thermonuclear fusion). This gathering and releasing balances a protostar, and it begins evolving into a star like the Sun.

A protostar that is too small to become a star is called a **BROWN DWARF.** It produces heat for a few million years.

Each fingerlike projection of this giant molecular cloud in the Eagle Nebula is larger than our solar system.

SUPER STARS



Hypergiant star Canis Majoris

A star can shrink or grow. Small stars last longer than large stars.

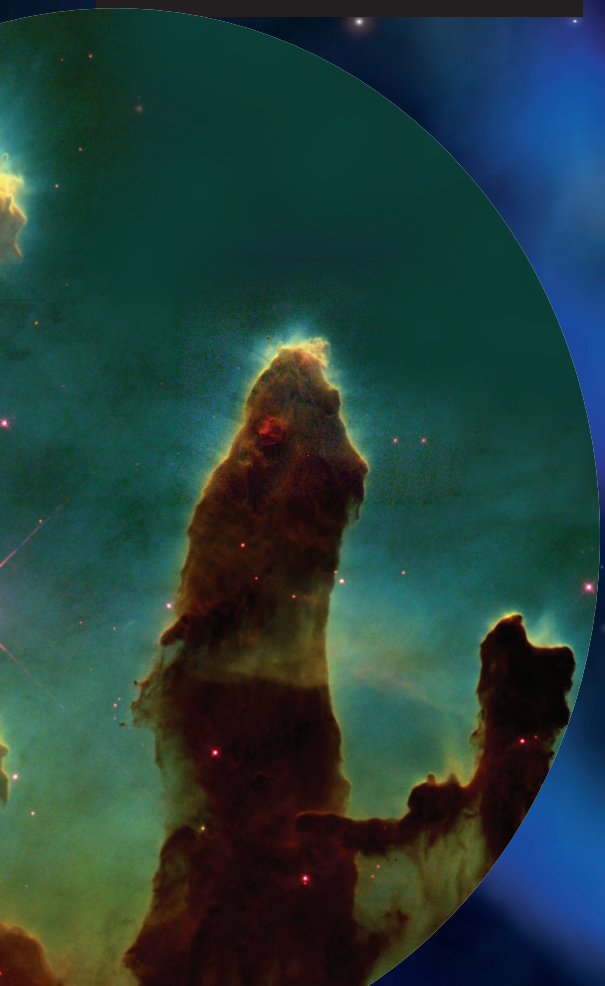
Stars usually begin as dwarf stars. These are small, but they can last for millions (even billions) of years. The Sun is a dwarf star.

DWARF stars can become giants, supergiants, or hypergiants.

A **GIANT** star can be 200 times as wide as the Sun and 1,000 times as bright.

A **SUPERGIANT** star can be 1,000 times as wide as the Sun and 10 million times as bright.

A **HYPERGIANT** star can be 2,100 times as wide as the Sun and up to 40 million times as bright. (Hypergiant stars last only a few million years.)



BIG RED

Betelgeuse is a red supergiant star that is 14,000 times brighter than the Sun and about 20 times as massive. If it were where the Sun is now, it would extend past Jupiter.

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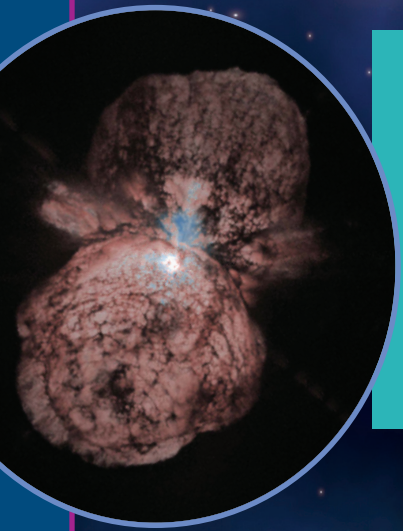
The binary star system RS Ophiuchi contains a white dwarf star and a red giant star that orbit around each other.



BIG BLUE

Hypergiant Eta Carinae is called a luminous blue variable (LBV) because it emits lots of energy, is extremely *hot*, and varies in brightness.

FADING STARS

★ When stars run out of fuel, they die. How this happens depends on their mass.

A WHITE DWARF is a small, dense, dying star that releases an expanding gas shell called a PLANETARY NEBULA. Stars the size of the Sun will eventually become white dwarfs.

Scientists think that white dwarfs become BLACK DWARFS. A black dwarf star emits no light. (There are no known black dwarfs in the universe.)

A large star can collapse in an explosion called a SUPERNOVA when it dies. (When a hypergiant does this, it's called a HYPERNOVA.) Gas and debris are violently ejected and the core of the star shrinks into a NEUTRON STAR.

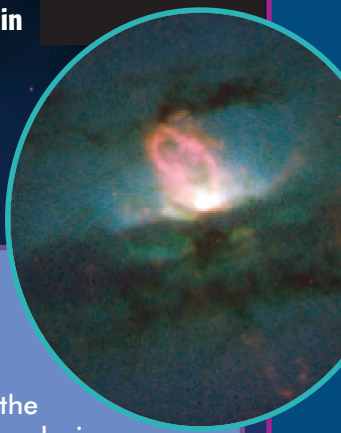
Supernova 1987A in the Large Magellanic Cloud

A neutron star is small (6 to 12 miles wide) but dense: One teaspoonful of a neutron star would weigh as much as a small mountain on Earth. A neutron star spins very fast—as much as hundreds of times per second.

A **PULSAR** is a type of neutron star that emits energy in pulses, sort of like a light beam from a lighthouse.

When a massive star dies and collapses, it can form a **STELLAR BLACK HOLE**. The gravity of a black hole is so strong that it even pulls in light.

A supermassive black hole in Galaxy NGC 4438



- A **MID-MASS BLACK HOLE** has a mass of hundreds to thousands of Suns.
- A **SUPERMASSIVE BLACK HOLE,** with a mass millions to billions of times greater than that of the Sun, is thought to be at the center of most large galaxies.