

Chapter 9: The Lives of Stars



Where do Stars Come From?

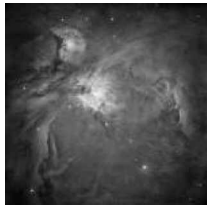
Some stars are old, but others are very young; they must have just formed.

What could these stars form out of?
Empty Space?

Space is Not _____



The Constellation Orion

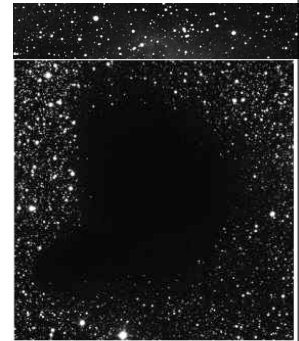


The Orion Nebula

This material between the stars is called the _____
It is very *diffuse* and thin.... In fact it is almost a vacuum.

How do we know it's there?

1. _____
2. _____
3. _____



The Interstellar Medium (ISM)

The Interstellar Medium is composed of:

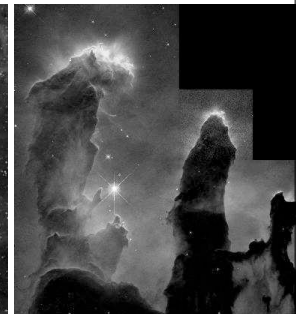
■ Gas (99%) and Dust (1%) by mass

- _____ (~75%)
- _____ (~25%)
- _____ (< 1%)

The ISM is Visible as _____ Called **Nebulae**



The Eagle Nebula
(ground based photo)



Eagle Nebula Close Up
(Hubble Space Telescope)

Three Kinds of Nebulae

- 1) _____ Nebulae
- 2) _____ Nebulae
- 3) _____ Nebulae

The Fox Fur Nebula

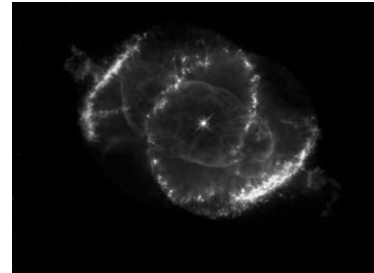
Emission Nebulae (HII Regions)

HII = Ionized Hydrogen

Hot star shines on
a gas cloud,
_____ the gas

Electrons jump to
_____ energy levels

When they fall back
to ground state they
produce _____
lines.



The Cat's Eye Nebula

Reflection Nebulae

When a **cooler** star illuminates a cloud of gas and dust, star
light is _____ by the dust

A reflection nebulae always
appears _____

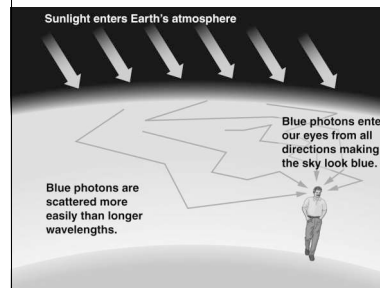


Reflection
Nebula near
The Pleiades

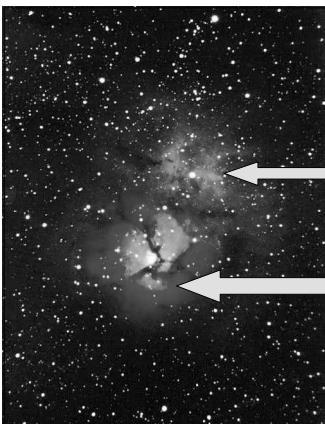


Close Up

Blue Reflection Nebulae and the Blue Sky



_____ *wavelengths*
(blue light) are
scattered more
easily than
_____ *wavelengths*
(red light) by
small particles



The Trifid Nebula

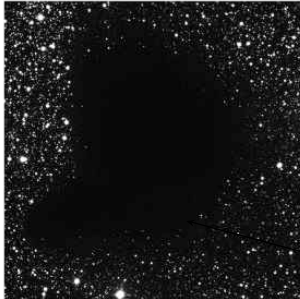
- Reflection (blue) -> _____ star
- Emission (red) -> _____ star

Dark Nebulae

Dense clouds
of gas and
dust can
_____ the light
from the stars
behind them.

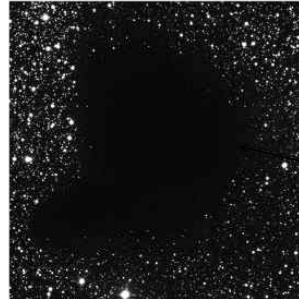


Where did the stars go?



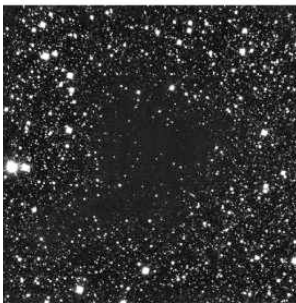
- Interstellar Dust is in the way!
- Solid particles _____ light coming from stars
- Stars near edges appear red because of _____

Interstellar Reddening



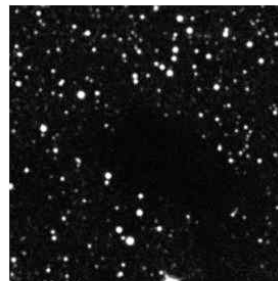
Dust blocks (shorter- λ) _____ light better than (longer- λ) _____ light

Interstellar Reddening



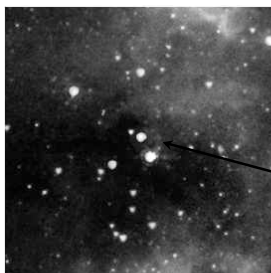
Observations of _____ light reveal stars on the other side of the cloud

Observing _____ Stars

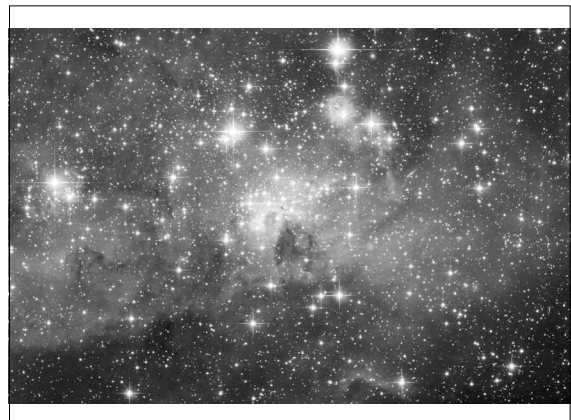


Visible light from a newborn star is trapped in the gas clouds

Observing Newborn Stars



Observing the cloud in IR light can reveal the newborn star

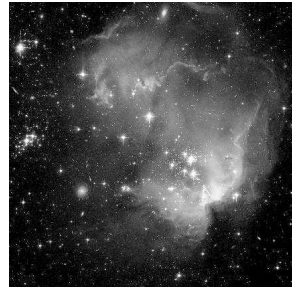


How do stars form?



- One of the 3 “origins” questions
- 2 Methods:
 - Collapse caused by _____
 - Collapse caused by _____

Cloud Collapse



A star-forming nebula

How does a thin cold cloud of gas and dust become a dense hot shining star?

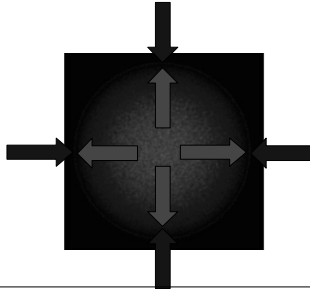
The problem is _____:

ISM: 10^3 atoms/cm³
Star: 10^{23} atoms/cm³ !

To become a star, the cloud must _____ tremendously

Gravity versus Pressure

- Gravity can create stars only if it can overcome the force of _____ in a cloud



Star Formation

1. Start with a cloud - ISM
2. Form little _____ regions
 - a. From collapse
 - b. From shock waves
3. Dense regions collapse under _____
4. Dense regions get _____

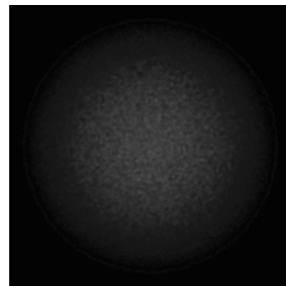


Fragmentation of a Cloud

- Gravity can overcome pressure in small pieces of the cloud
- Gravity becomes stronger as the gas becomes _____
- Gas becomes denser, core becomes _____

Fusion!

Fragmentation of a Cloud



- This simulation begins with a turbulent cloud containing 50 solar masses of gas

Fragmentation of a Cloud



- The random motions of different sections of the cloud cause it to become _____

Fragmentation of a Cloud



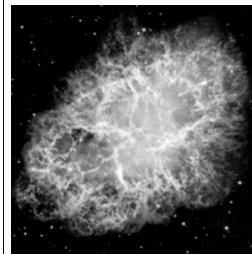
- Each lump of the cloud in which gravity can overcome pressure can go on to become a star
- A large cloud can make a whole _____ of stars

Isolated Star Formation



- Gravity can overcome pressure in a relatively small cloud if the cloud is unusually dense
- Such a cloud may make only a single star

Star Formation from Shocks

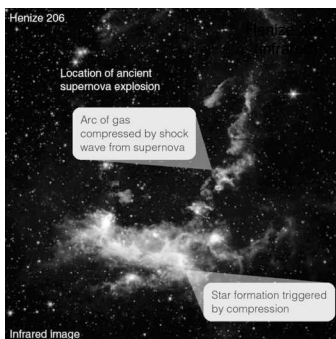


When a high mass **O type** star ends its life, it explodes as a **supernova**

Material from the exploding star might collide with a nebula in its path....

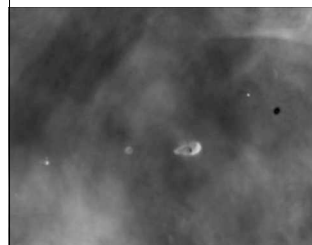
Crab Nebula: A Supernova which exploded in 1054 AD

Shocks Triggering Star Formation



Shock waves can "push" material together in a cloud, creating _____

Protostars



Proto-Planetary System in The Orion Nebula.

Part of a nebula condenses into a knot of gas called a **protostar**.

Protostars are surrounded by material which can form _____.