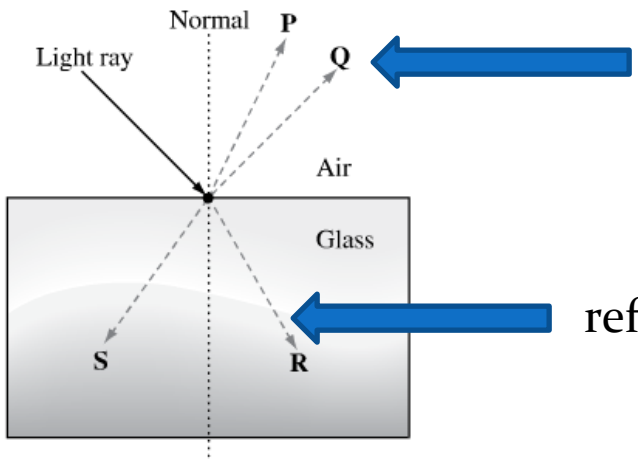
Sample Diploma Problem

Use the following information to answer question 14.

Diagram of Light Ray Interacting With Glass



reflection

refraction

14. *In the diagram above, the path of the reflected light ray is labelled* ___*i*___ *, and the path of the refracted light ray is labelled* ___*ii*___ *.*

The statement above is completed by the information in row

Row	*i*	*ii*
A.	Q	P
B.	Q	R
C.	S	P
D.	S	R

Sample Diploma Problem

Use the following information to answer question 15.

In Hawaii, scientists are using a telescope that has a curved mirror with a diameter of 3.6 m to look for asteroids that may pose a threat to Earth.

15. The type of telescope described above is

A. a refracting telescope
B. a reflecting telescope
C. an X-ray telescope
D. a radio telescope

Refracting: 2 lenses
Reflecting: curved mirror
Xray: no reflecting system
Radio: large dish operates day or night

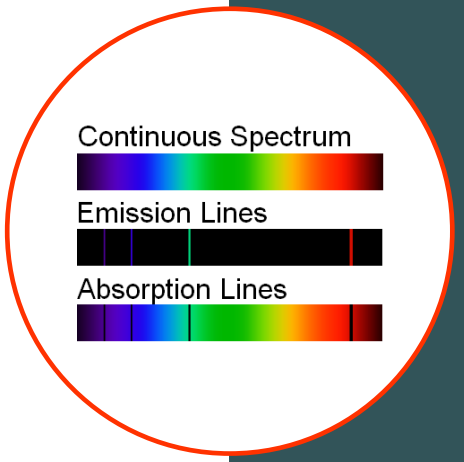
Astronomy

Curriculum

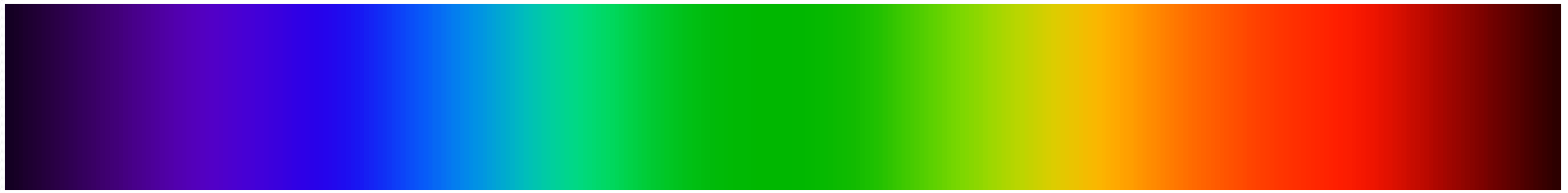
- describe, in general terms, how a spectroscope can be used to determine the composition of incandescent objects or substances, and the conditions necessary to produce emission (bright line) and absorption (dark line) spectra, in terms of light source and temperature
- describe technologies used to study stars:
  - spectroscopes used to analyze the distribution of energy in a star's continuous emission spectrum can be used to estimate the surface temperature of the star
  - Doppler-shift technology used to measure the speed of distant stars provides evidence that the universe is expanding
- describe, in general terms, the evolution of stars and the existence of black holes, white dwarves and neutron stars.

Star Composition

- When light from a star is passed through a prism, it creates a rainbow-like pattern called a **continuous spectrum**
- However, the patterns from stars often have black "gaps" in them called **absorption or dark line spectrums**
- These gaps are due to gases absorbing specific wavelengths of light
- If you take a gas an excite it, then pass it through a prism, you can see a **bright line or emission spectrum**
- These gaps can then be compared to known gases and will identify the star's composition

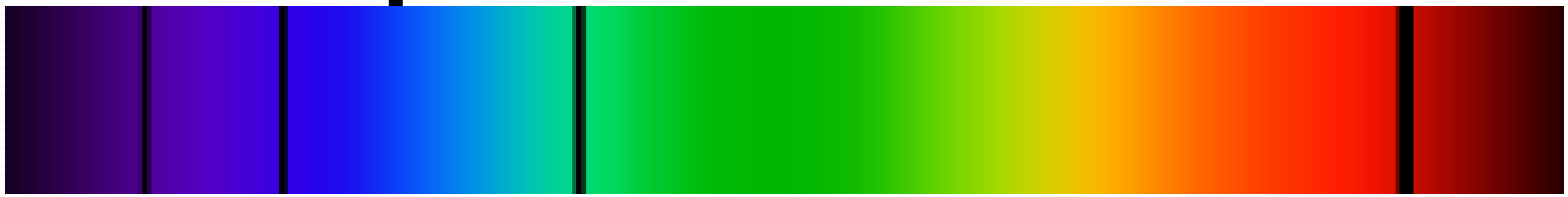


Continuous Spectrum



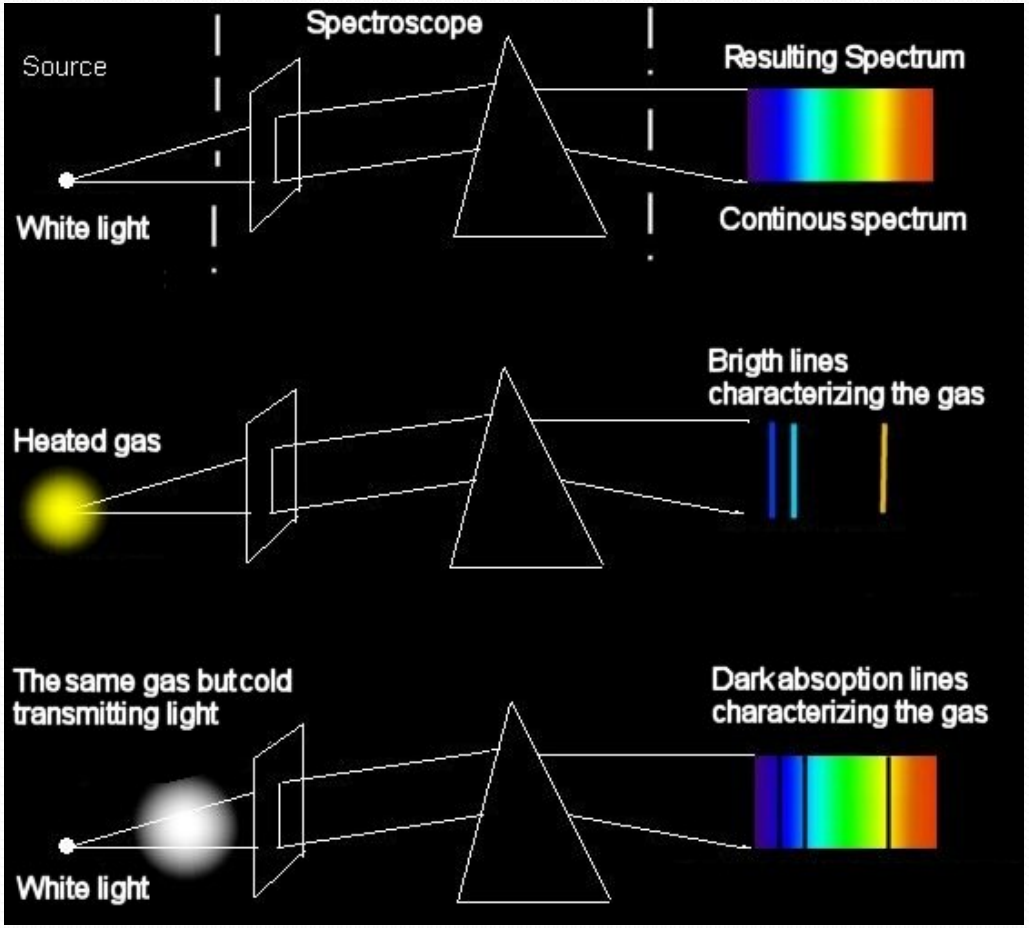
Emission Lines

Absorption Lines



Spectrums

Incandescent light bulb



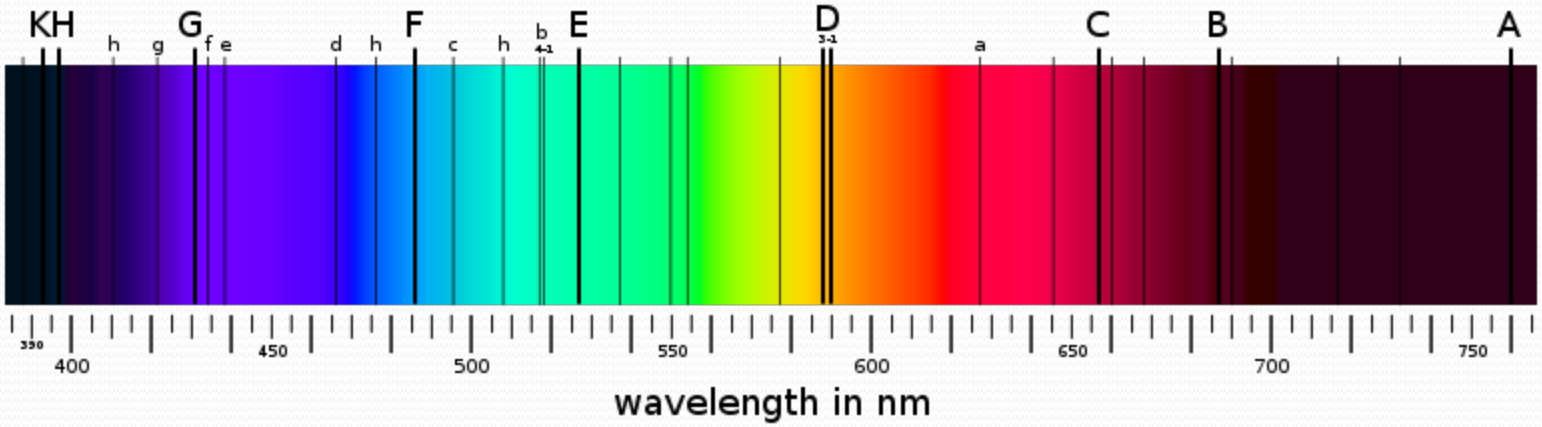
Continuous spectrum

Emission lines

sun

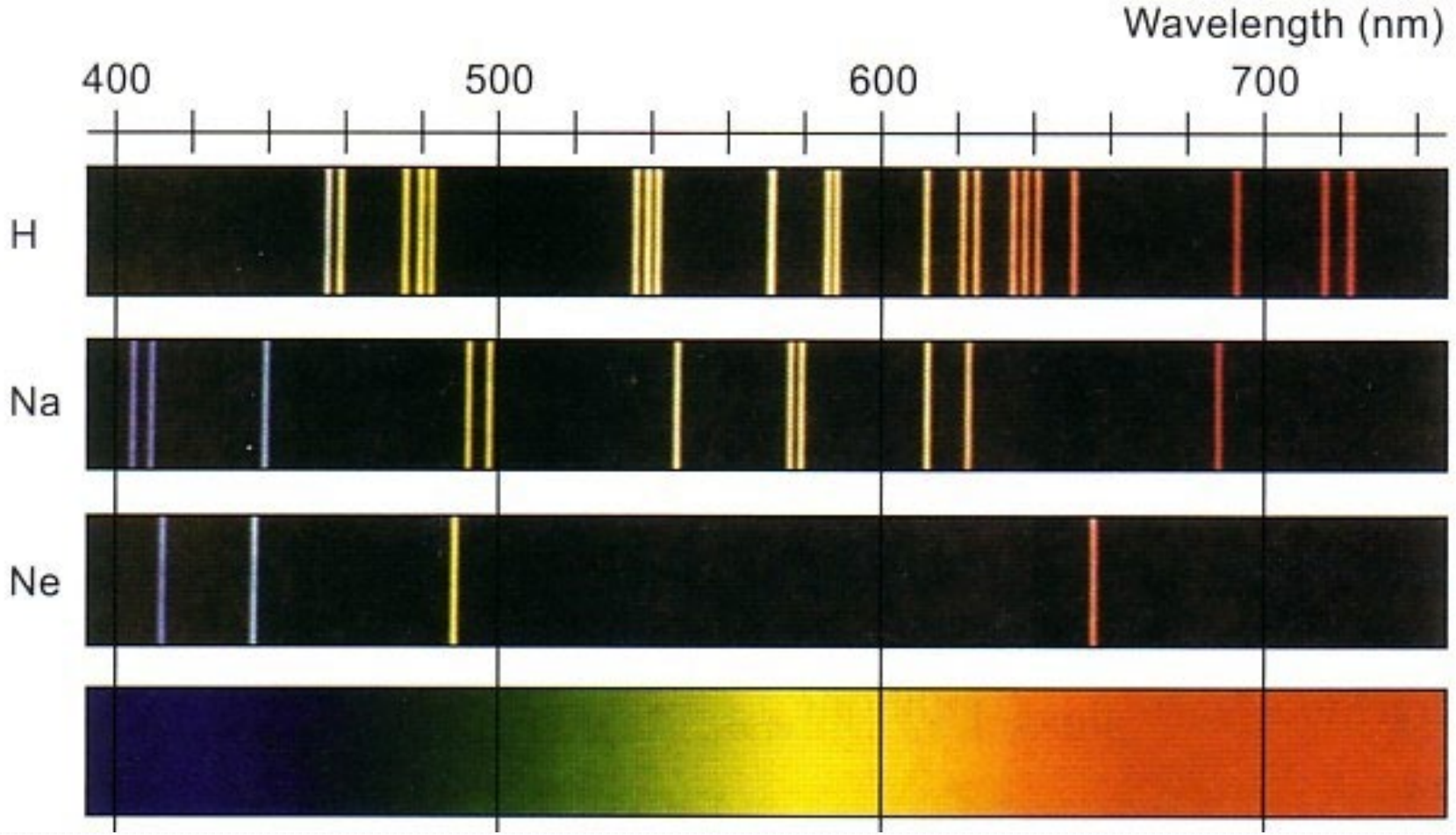
Absorption lines

Fraunhofer Lines

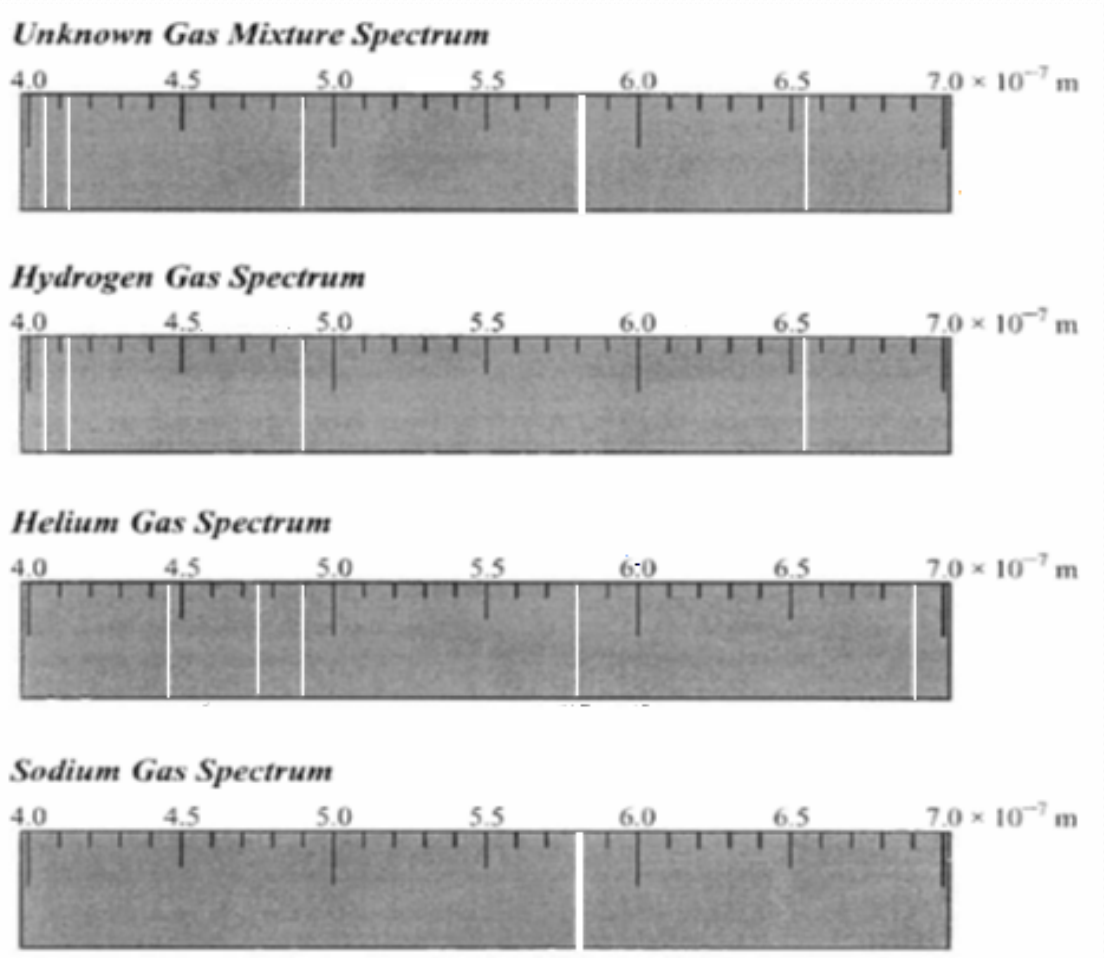


- The sun is a hot incandescent body and gives off light at all frequencies
- The cool gases outside the sun absorb frequencies characteristic to each element
- These Fraunhofer lines tell scientists what stars are made up of

Element Spectrum

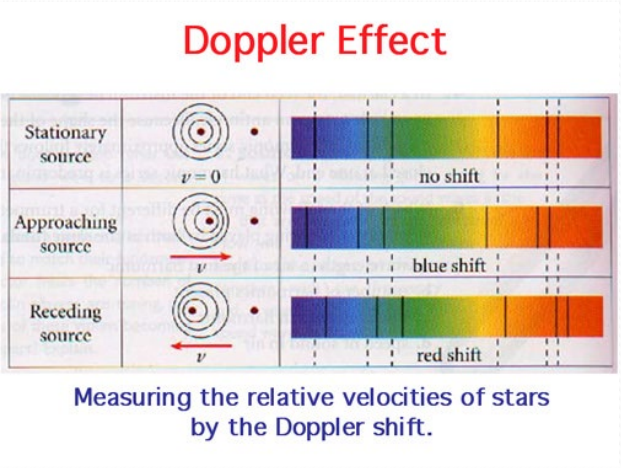


Example

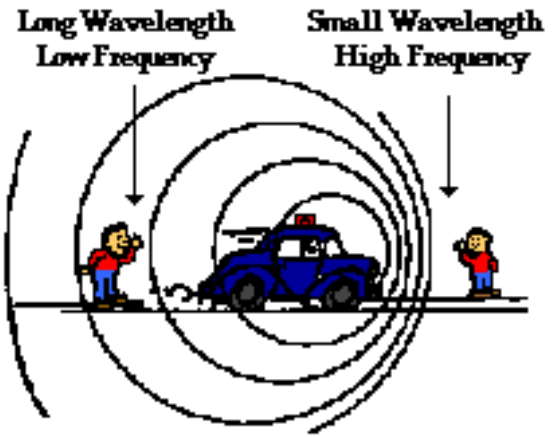

Unknown Gas Mixture Spectrum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 × 10⁻⁷ m
Hydrogen Gas Spectrum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 × 10⁻⁷ m
Helium Gas Spectrum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 × 10⁻⁷ m
Sodium Gas Spectrum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 × 10⁻⁷ m

Doppler effect

- Sound pitch can change depending on the relative motion of the sound source and the observer.



Measuring the relative velocities of stars by the Doppler shift.



The Doppler Effect for a moving sound source

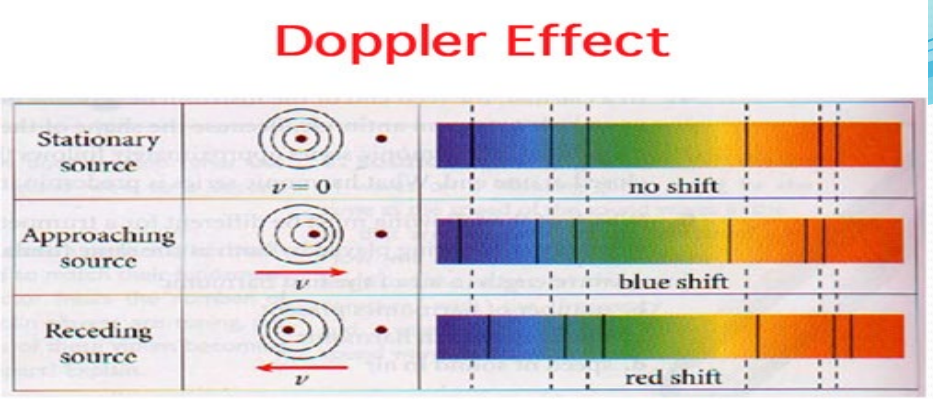
Doppler Effect

Doppler Effect

As wavelength increases, frequency decreases

As wavelength decreases, frequency increases

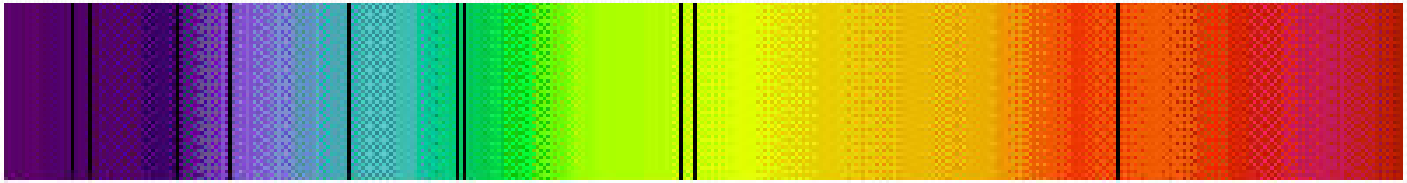
Red Shift



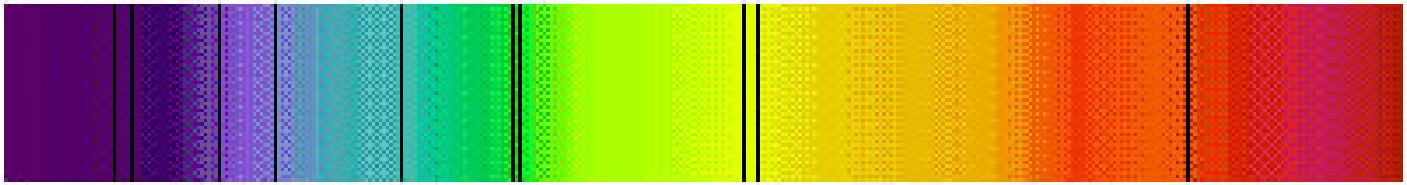
Measuring the relative velocities of stars by the Doppler shift.

- A practical use of the Doppler effect is in radar guns used by the police and sporting events to determine speeds
- More importantly, in 1928, Edwin Hubble used the Doppler effect to explain the apparent "Red Shift" of most observed stars
- Red is the lower frequency end of the visible spectrum, therefore a shift to the red means that most stars are moving away from our star

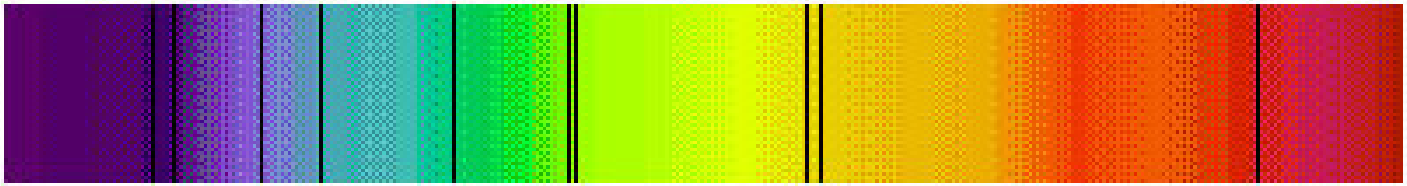
Red Shift



moving toward you: blueshift



at rest



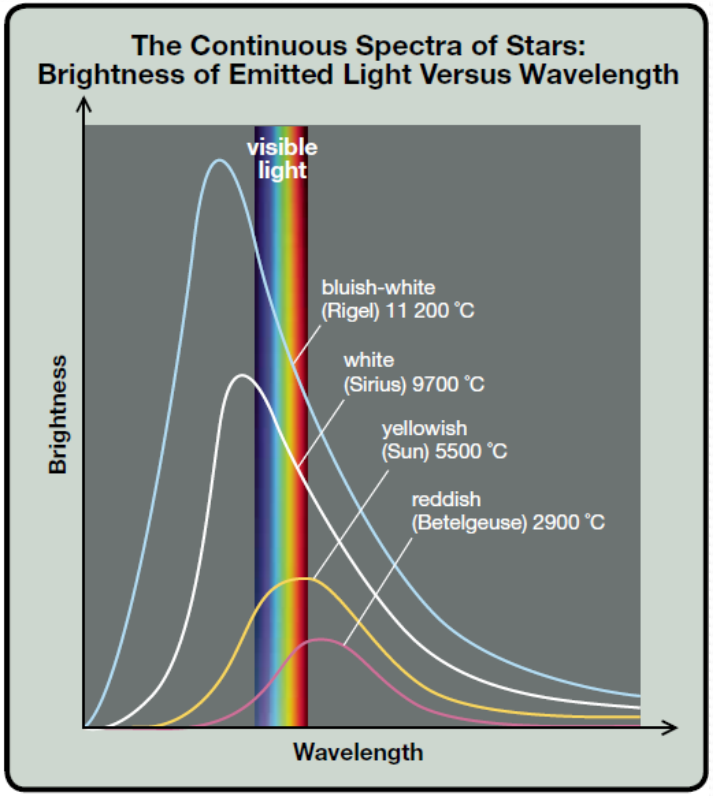
moving away from you: redshift

Red Shift

- Since all the stars are moving away from us the universe must be expanding
- By calculating its speed of expansion we can deduce its origin from a single point
- This original point is the Big Bang, which was the beginning of the universe.

Classification of Stars

- Star color can be used to classify stars based on their temperature



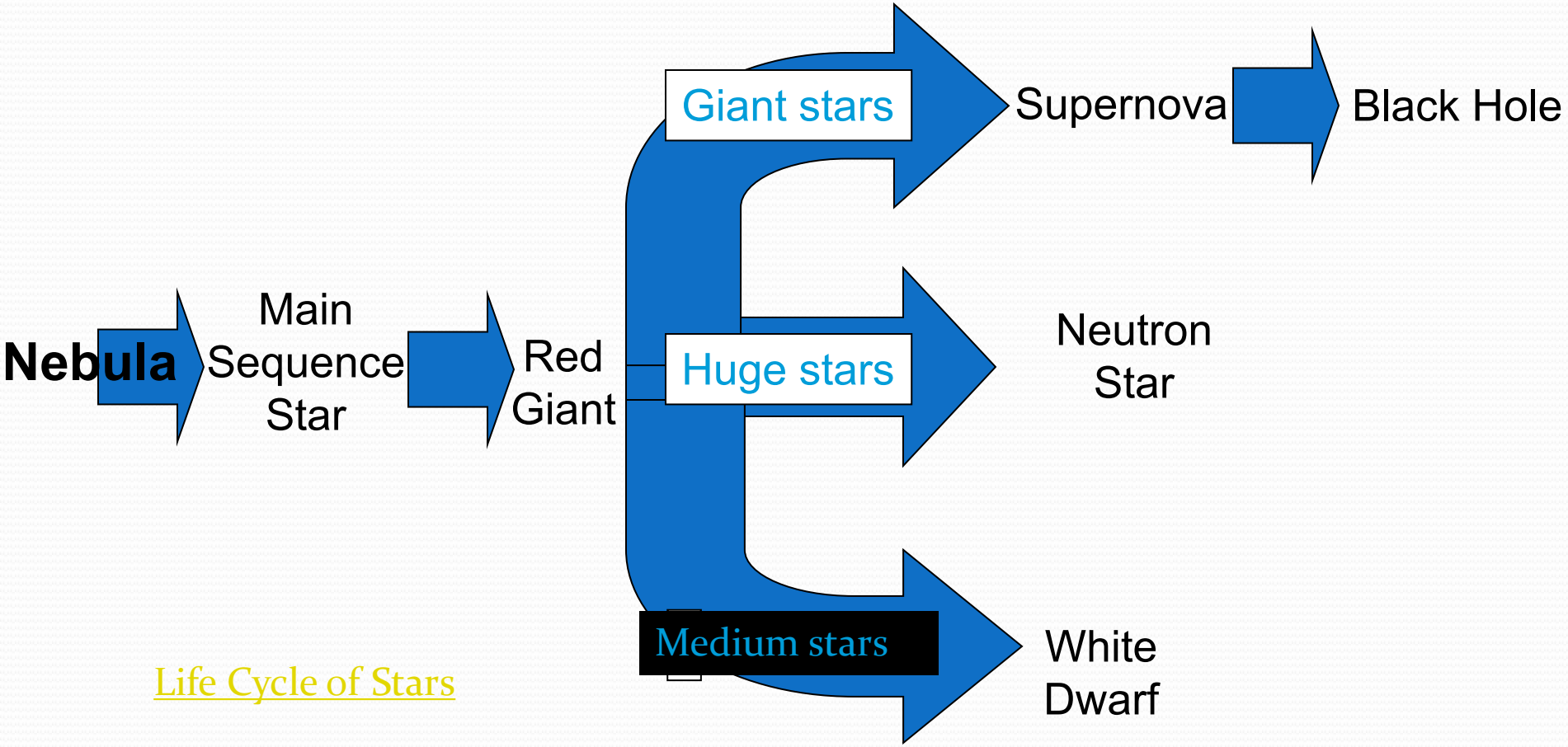
The Birth of a Star

- Stars form in clouds of dust and gas known as **nebula**
- The gravitational attraction between the particles creates a small ball of matter, and draws in more dust and gas
- As this occurs, the protostar's temperature increases and it begins to glow
- At temperatures above 10 000 000 ^{o}C, hydrogen atoms begin the process of fusion, and a star forms

The Death of a Star

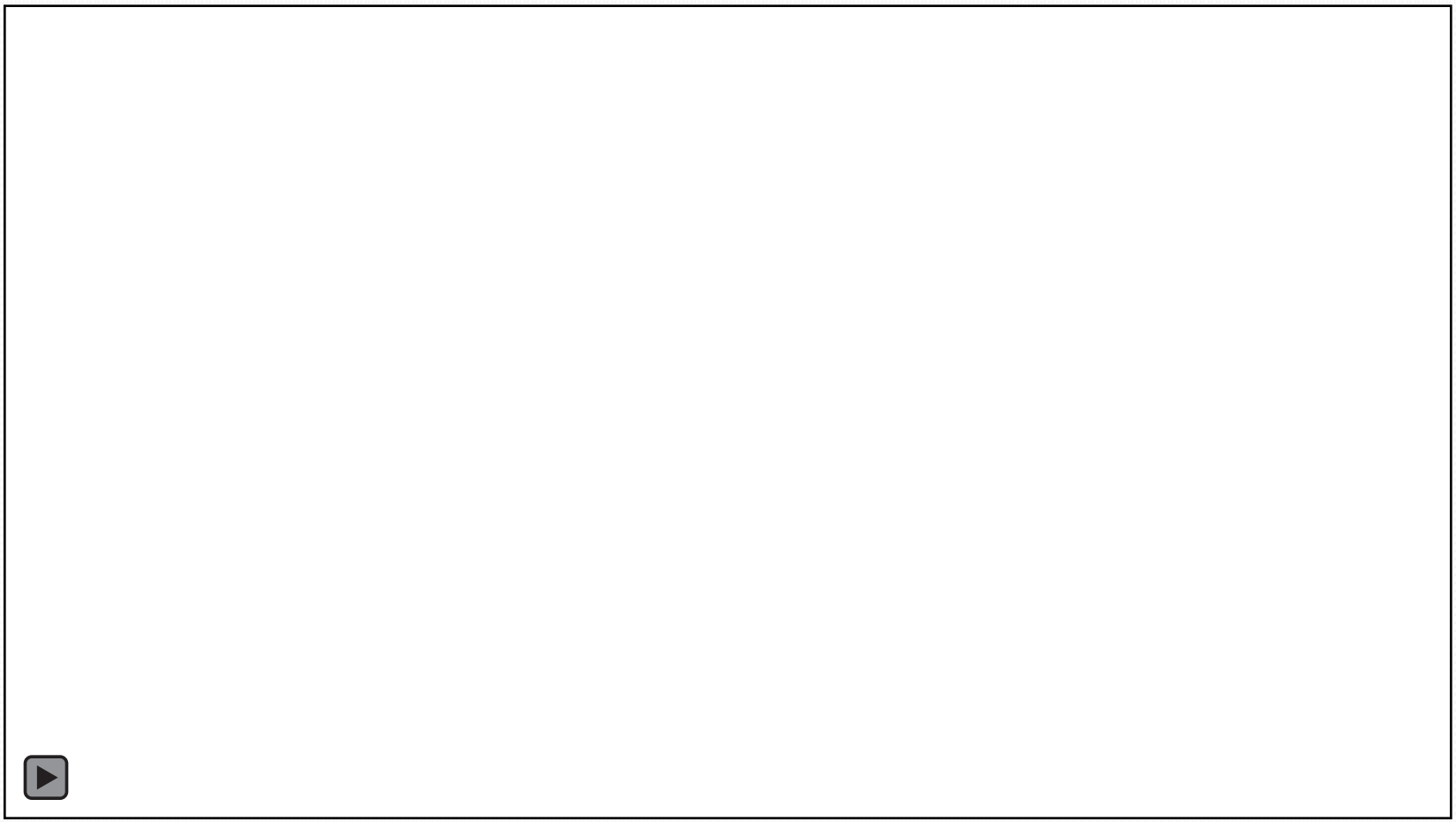
- As the fuel in a star dwindles, it becomes a **red giant** star
- Eventually the fusion reaction stops and the star collapses to form a **white dwarf** star
- If the star is larger is can create a **neutron star**
- Very massive stars collapse rapidly, creating a massive shock wave known as a supernova
- If there the star has a marge enough mass, a **black hole** is formed

Summary: Life Cycle of a Star

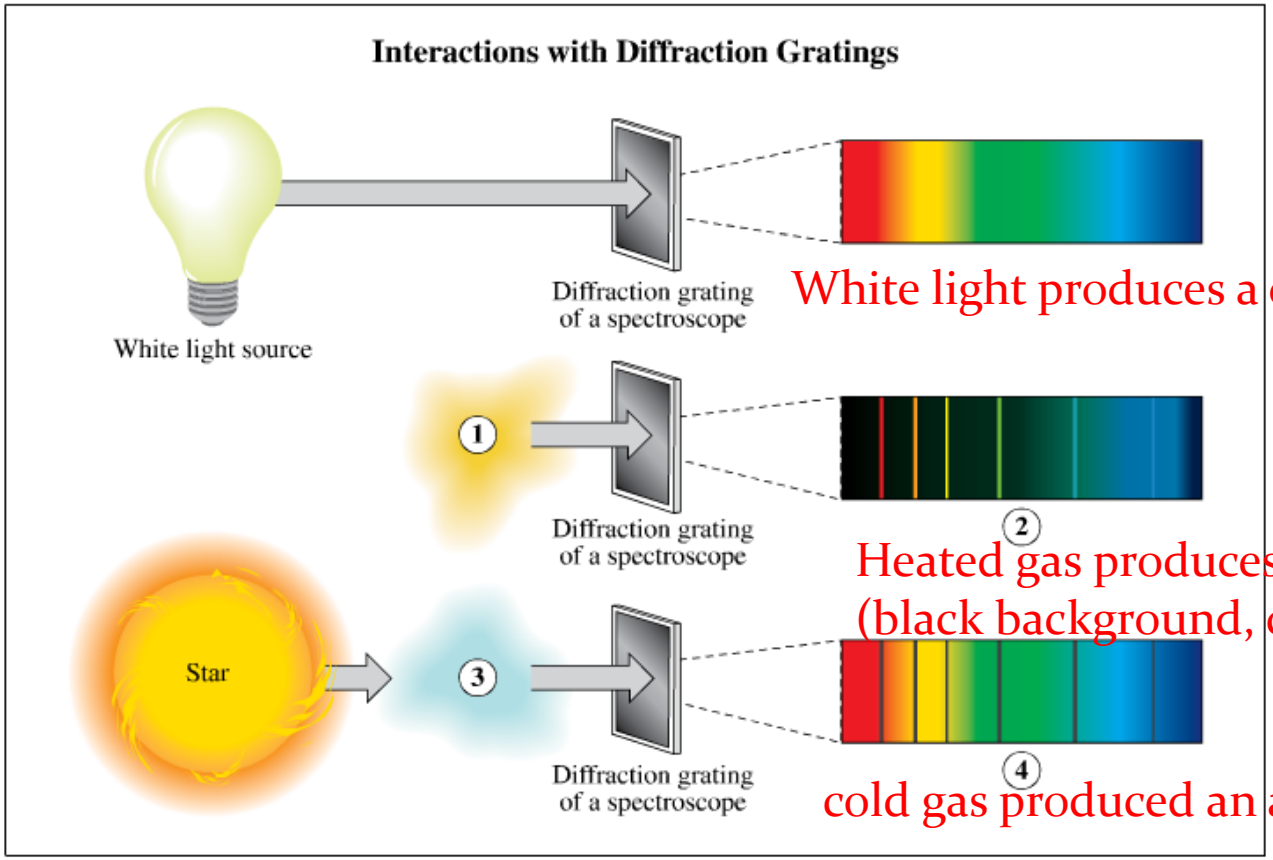


Life Cycle of Stars

Life of a star video (5 min)



Use the following information to answer numerical-response question 11.



White light produces a continuous spectrum

Heated gas produces a emission spectrum (black background, colored lines)

cold gas produced an absorption lines

Numerical Response

11. Match the sections of the diagram numbered above to the terms below. Use each number only once.

Section:	_____,	1,, 3, 4, 2,	_____,	_____,	and	_____.
Term:	**Relatively hot gas**		**Relatively cool gas**	**Absorption spectrum**		**Emission spectrum**

(Record all **four digits** of your answer in the response boxes at the bottom of the screen.)

Sample Diploma Problem

16. When compared with electromagnetic radiation (EMR) emitted from a stationary light source, the waves of light from a light source that is moving away from an observer will have

A. increased frequency and decreased wavelength

B. increased frequency and increased wavelength

C. decreased frequency and decreased wavelength

D. decreased frequency and increased wavelength

moving toward you = blue shift
Higher frequency, small wavelength

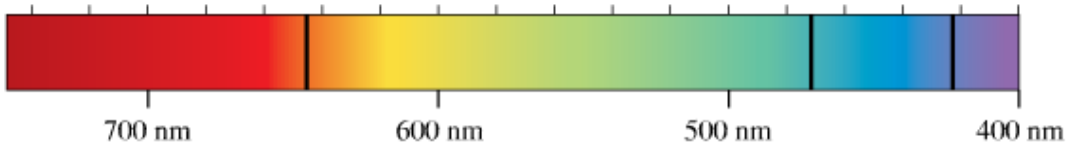
Moving away = red shift
Lower frequency, high wavelegth

Use the following information to answer question 17.

Hydrogen Spectra Observed by an Astronomer

Standard Hydrogen Spectrum

Hydrogen Spectrum of a Celestial Body



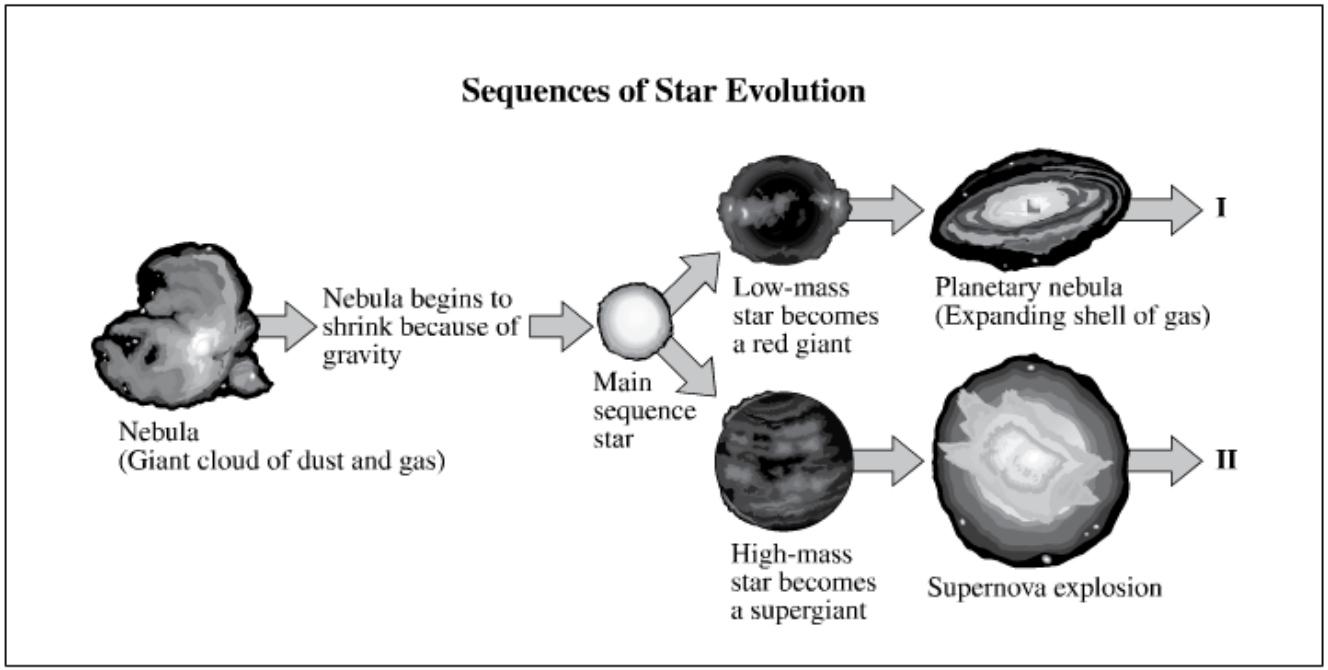
17. *Compared with the standard hydrogen spectrum shown above, the hydrogen spectrum of the celestial body is* ___*i*___ *, which indicates that the celestial body is moving* ___*ii*___ *the astronomer.*

The statement above is completed by the information in row

Row	*i*	*ii*
~~A.~~	~~red-shifted~~	~~toward~~
~~B.~~	~~red-shifted~~	away from
C.	blue-shifted	toward
D.	blue-shifted	away from

Moving away = red shift
Moving toward = blue shift

Use the following information to answer question 18.



18. Which of the following rows identifies the **most likely** end products of each of the two star sequences in the diagram above?

Row	I	II
A.	White dwarf	Black hole
B.	White dwarf	Low-mass star
C.	Black hole	White dwarf
D.	Black hole	Low-mass star