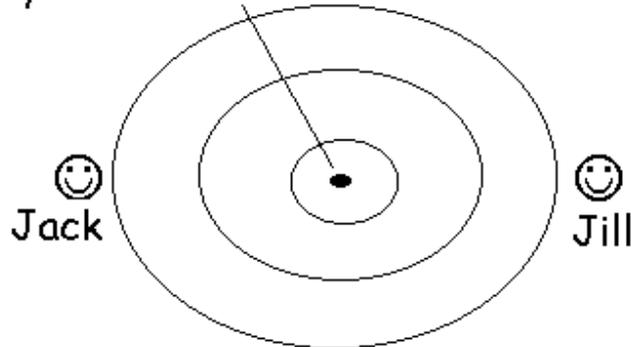


The Expanding Universe

Doppler effect -

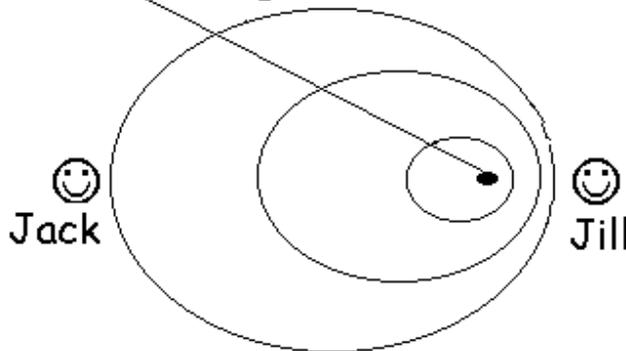
Stationary Sound Source



They both hear the same sound!

Sound Source Moving Towards Jill

Jack hears a low pitch



Jill hears a high pitch

The frequency of sound increases as the source moves **towards** you and the frequency decreases as it moves **away**.

Light is also a wave (like sound) only now the **colour** changes if the object is moving. An object moving away from us changes to more of a **red** colour. This is called a **RED-SHIFT**. An object moving towards us changes to more of a **blue** colour. This is called a **BLUE-SHIFT**.

See Figure 4 page 223

Hubble - finds most galaxies are **red** shifted AND the further away the galaxy the **bigger** the red shift. This means that most galaxies are moving away from us and the further away the galaxy the faster it is moving away!

How can this be? The whole universe must be !

Do Activity 4.14 - page 224.

	Measured Distances					
	a→b	a→c	a→d	XX	XX	XX
small sphere	1.1	.75	1.5	XX	XX	XX
Large sphere	3.1	2	4	XX	XX	XX

#6 All distances increased. The distances that were originally larger increased the most.

#7a) D moved away the most quickly

b) C moved away the most slowly

c) None of them moved towards you!

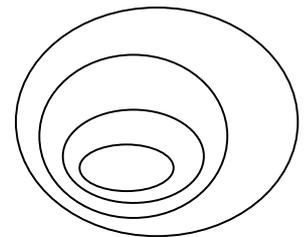
#8 The galaxies that are Farther from Earth seem to be moving away from Earth faster than the galaxies that are closer to Earth.

If the universe is expanding as we go forward in time, then as we go backwards in time, the universe would be **getting smaller**. At some point in the very distant past (**14 billion** years ago) everything must have been in one place. All that matter and energy would make things very **hot** and explosive. This is the **BIG BANG** Theory of the origin of the Universe. We are still inside the explosion that is our Universe!

Read Sections 4.13 and 4.14

Do questions #1-4 page 223 .

1. From the diagram on the right, label the ripples that have shorter wavelengths and those that have longer wavelengths. Indicate the direction of movement of the object causing the waves.
2. What does 'red shift' mean?
3. If astronomers were to observe a 'blue shift' for a certain star, what could they conclude? Why?
4. Sketch a diagram of the ripples that an object travelling from the top to the bottom of this page would make.



Do Questions #1 and 2 from page 225.

1.
 - a) What instrument does an astronomer use to determine the patterns of light of a star or galaxy?
 - b) What can the patterns of light tell a scientist about a star or galaxy?
 - c) Why is using the instrument from (a) better than using only a telescope?
2. Although the balloon model was useful to illustrate an expanding universe, it had a major limitation. What was that limitation? (Hint: What about the galaxies that are inside the balloon?)