



Name: _____

Class: _____

Student worksheet

6.5 The Big Bang theory is supported by evidence

Pages 148–149

Our expanding universe

1 What is the Big Bang theory?

2 Why might the word 'bang' to describe the beginning of the universe be misleading?

3 Use the table below to summarise the key evidence for the Big Bang theory.

Aspect of Big Bang theory	Key evidence
Microwave background	
Mixture of elements	
The universe is changing	

4 Some scientists say that when we examine distant galaxies, we are looking back in time. What do they mean by this?

Extend your understanding

In 1925 American astronomer Edwin Hubble took a series of images of the nebula M31 (now popularly known as the Andromeda galaxy) and, on comparing them, discovered a Cepheid variable star that he called V1. He measured V1's period of pulsation to be 31.4 days.

Since a Cepheid variable star's period of pulsation determines its variation in magnitude, as discovered by American astronomer Henrietta Leavitt, Hubble was then able to calculate how far away V1 was from Earth. He did this by measuring V1's variation in brightness and, on comparing this with the absolute variation predicted by the relationship discovered by Henrietta Leavitt, Hubble calculated that M31 was 285 000 parsecs away from Earth – this led to it being classified as a galaxy in its own right, and not part of our Milky Way galaxy. The universe had suddenly become a very large place!

In 1929 Hubble published a paper that showed the results of his investigation of the relationship between a galaxy's radial velocity (derived from its Doppler shift) and its distance from Earth.



Edwin Powell Hubble

HUBBLE'S DATA

Object name	Distance (Mpc)	Velocity (km/s)
SMC	0.032	+170
LMC	0.034	+290
NGC 6822	0.214	−130
NGC 598	0.263	−70
NGC 221	0.275	−185
NGC 224	0.275	−220
NGC 5357	0.45	+200
NGC 4736	0.5	+290
NGC 5194	0.5	+270
NGC 4449	0.63	+200
NGC 4214	0.8	+300
NGC 3031	0.9	−30

Object name	Distance (Mpc)	Velocity (km/s)
NGC 3627	0.9	+650
NGC 4826	0.9	+500
NGC 5236	0.9	+500
NGC 1068	1.0	+920
NGC 1055	1.1	+450
NGC 7331	1.1	+500
NGC 4258	1.4	+500
NGC 4151	1.7	+960
NGC 4382	2.0	+500
NGC 4472	2.0	+850
NGC 4486	2.0	+800
NGC 4649	2.0	+1090

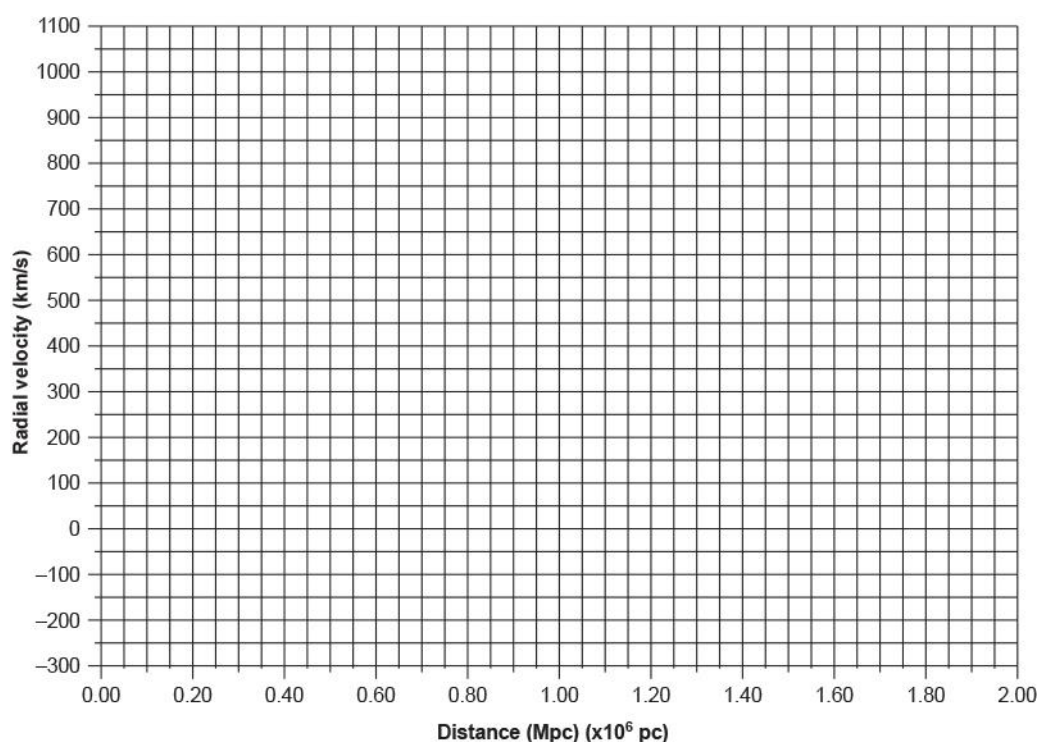
Note: 1 Mpc = 1 million parsecs = 1.0 × 10⁶ pc

5 Using the data in the above tables, plot a graph of radial velocity (km/s) against distance (Mpc) on the axes provided.



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- 6 What does the general trend of the data suggest about what is happening in the universe? Explain your answer.

- 7 Some of the radial velocities in Hubble's data were negative. What does this tell us about their motion? Can you think of a reason why this might be so, given that the radial velocities of all of the other galaxies have positive values?
