

Exploring the Big Bang Theory

Learning Outcomes in Focus

Contextual strand: E&S 2

Students should be able to **explore** a scientific model to illustrate the origin of the universe

EXPLORE: Observe, study in order to establish facts.

Nature of science: NoS 1

Students should be able to **appreciate** how scientists work and how scientific ideas are modified over time.

Learning Intentions

Students will learn to:

1. Study a model of the expanding Universe to establish how evidence supports the theory that the Universe is expanding.
2. Gain some practical understanding of how scientists develop scientific models to explain phenomena.

Prior Learning

Students have researched the BIG Bang theory and learned that:

- The Big Bang created space and matter
- The universe is expanding
- Our early universe was simple, as it expanded atomic matter formed
- Gravity caused atoms to form galaxies and solar systems

Exploring the BIG Bang Theory (Teacher background)

The Big Bang theory suggests that our Universe is expanding. In this activity students will explore a model to see whether evidence exists to support this. For the theory to be supported students should find that

1. All objects in our Universe must be moving away from each other.
2. Objects that are further away from us are moving away from us more quickly than objects that are close to us.

Using data gathered from observing the movement of galaxies, scientists can develop a two-dimensional model of an imaginary galaxy field, where galaxies are represented by dots as shown on Student Worksheets Galaxy Field A and B. In a real galaxy field image, the galaxies do not have a regular shape and are not as evenly spread. The model works on the premise that the image presented as Student Worksheet Galaxy Field B was taken one second after Student Worksheet Galaxy Field A and so represents the passing of one second.

NOTE: Each group needs one copy of Student Worksheet Galaxy Field A, one copy of Student Worksheet Galaxy Field B and also a copy of Student Worksheet Galaxy Field B copied onto a transparency.

Using data gathered from observing the movement of galaxies, scientists can develop a two-dimensional model of an image (or picture) of a section of the Universe. In this model galaxies are represented by different sized dots as shown on Student Worksheets Galaxy Field A and B. Image B is also on a transparency for use later. The model works by imagining that image B was taken **one second after** image A.

1. On Student Worksheet A, measure and record the distance between 4 pairs of galaxies to complete the table. Before you begin, discuss where you will take your measurements from (e.g. the middle of the dot /near edge etc.). It doesn't matter where you choose so long as you always measure from the same place.

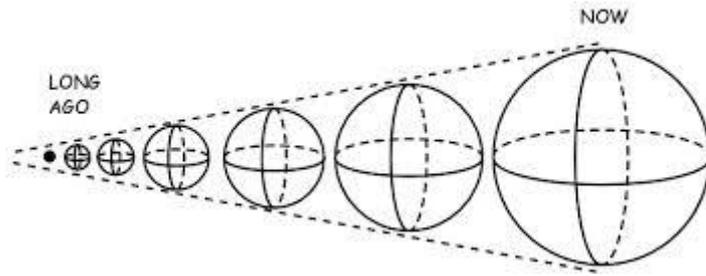
Named pair of Galaxies (e.g. A – C)	Distance between the galaxies

2. Now repeat FOR THE SAME PAIRS but using Student Worksheet B and record your results in the table below. Remember to measure from the point that you did in step 1 to allow for comparison.

Named pair of Galaxies (e.g. A – C)	Distance between the galaxies

3. If B represents an image of a galaxy field taken one second after the image A, discuss in your groups what has happened to the distances between the galaxies in that second.
4. Imagine your group were to stand on one of the galaxies A, B, C, D, E or F and you were looking out at all the other galaxies. Discuss in your groups whether you think the other galaxies would be moving towards you, away from you or staying in the same place.
5. Pick a galaxy to stand on. This galaxy will not appear to you to move. Lay the **transparency Galaxy Field B** on top of the sheet Galaxy Field A. Move the transparency so that your chosen galaxy on the transparency is **directly on top of** the same galaxy on the worksheet. Look at the other galaxies. In the passing of the second between image A and image B what has happened to the other galaxies? Discuss your observations in your group.
6. Now move to another galaxy and repeat the process, moving the transparency each time and making sure it is lined up correctly. Repeat for a third time, again moving the transparency. Discuss what you have observed in your groups and then attempt to answer the question overleaf.

7. The Big Bang theory suggests that the Universe is expanding since its origin.



Does what you have observed from the model provide you with any evidence to support this theory? Support your answer by referring to what you saw on the model.

8. For the final part of this activity imagine you are standing on galaxy B. Line up the transparency so that B on the transparency is on top of B on worksheet called Galaxy Field A. In the second between image A (on sheet) and image B (on transparency) measure how far each of these galaxies moved.

Galaxy	Distance in cm
A	
C	
D	
E	
F	

Use these results to help you with the next question.

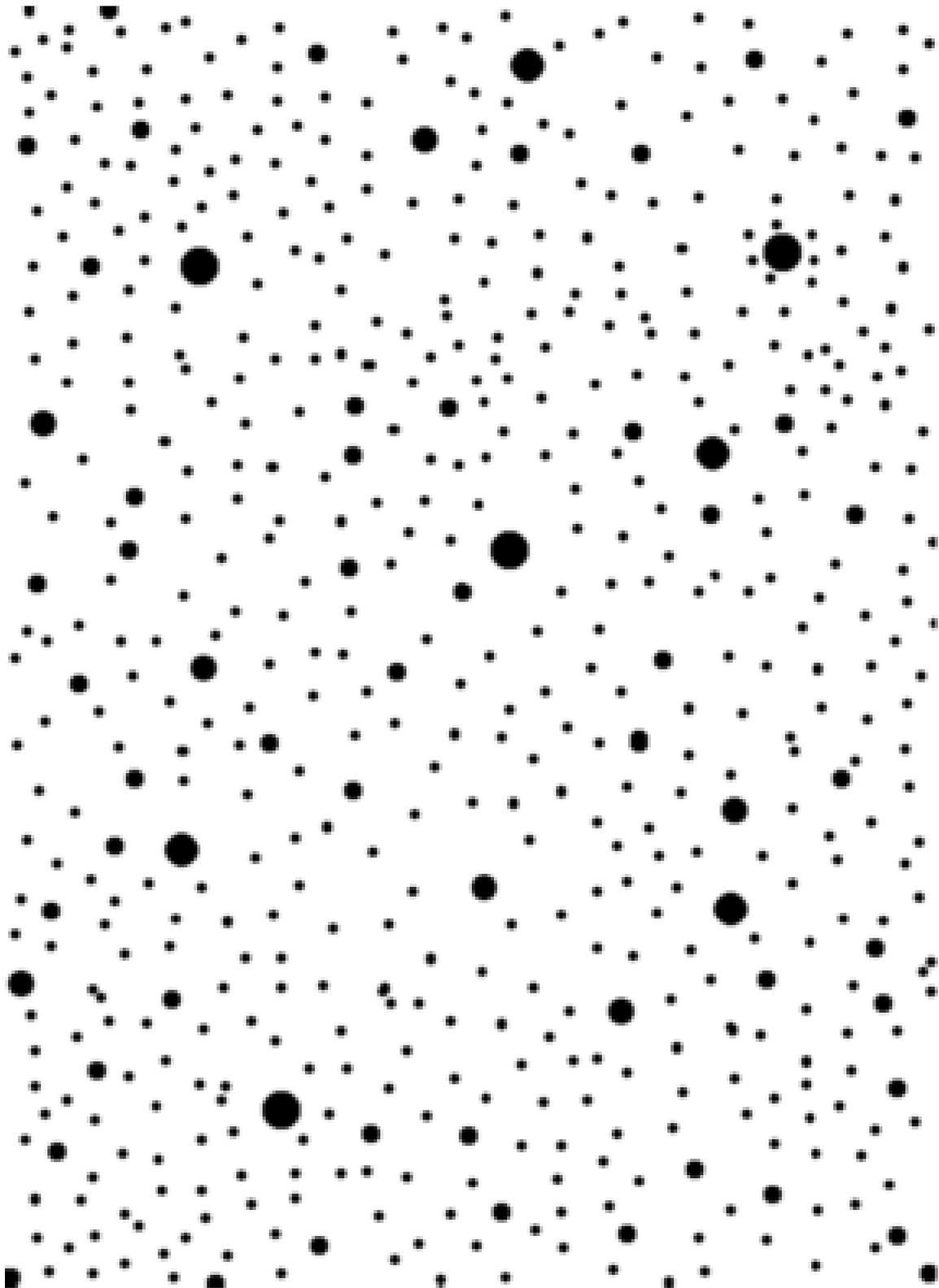
9. The Big Bang Theory suggests that if the Universe is expanding, then objects that are further away move away more quickly than objects which are close to us. Explain, with justification, how your observations support/do not support this aspect of the Big Bang theory.

Possible Extension Activity

The model was developed based on data recorded by scientists measuring the movement of galaxies. State two things that it suggests about the movement of galaxies.

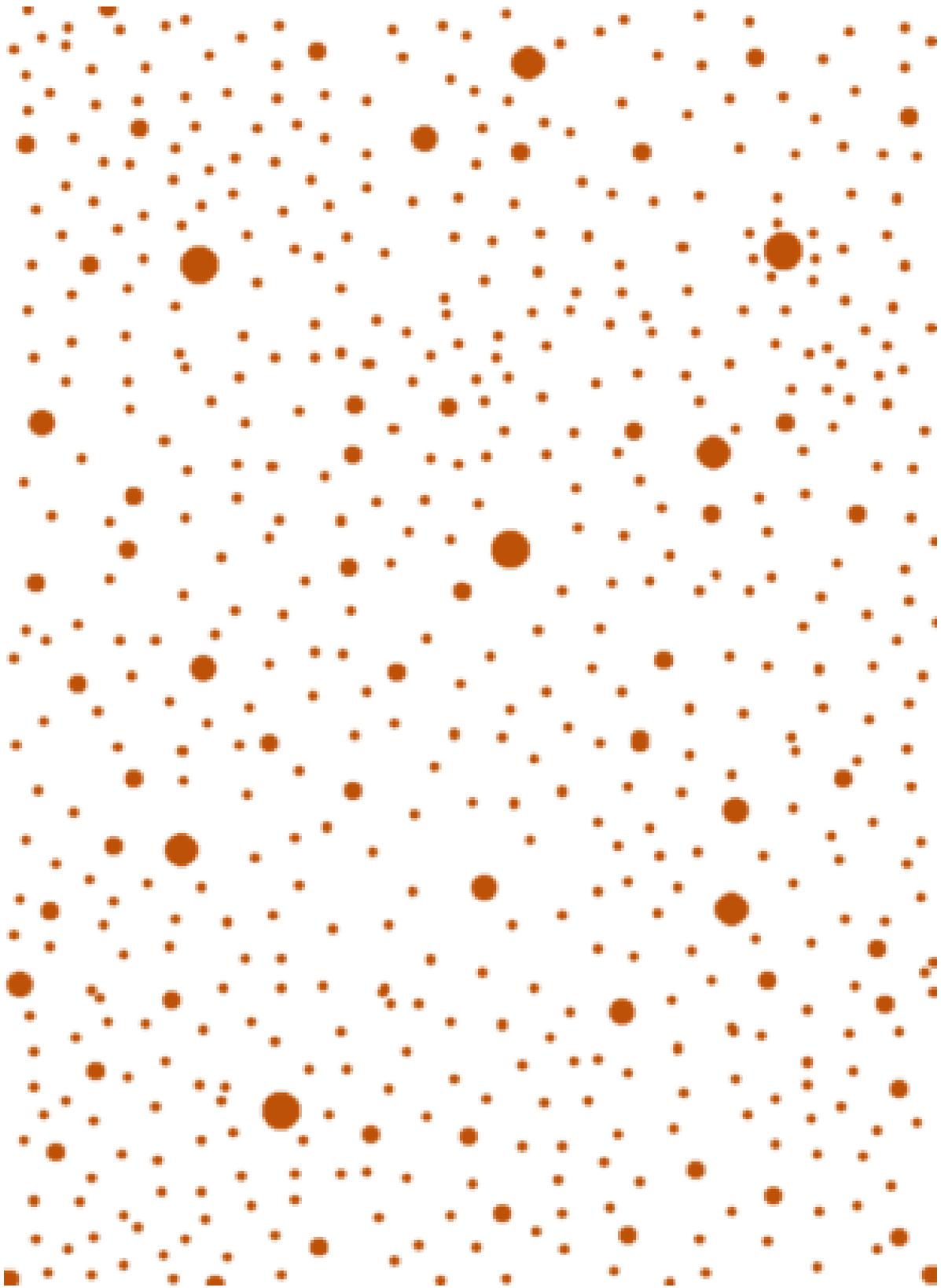
Are there any ways that the model is limited in how it supports the big Bang Theory?

GALAXY FIELD A



Adapted from "Modelling the Expanding Universe"- Astronomical Society of the Pacific

GALAXY FIELD B



Adapted from "Modelling the Expanding Universe" – Astronomical Society of the Pacific