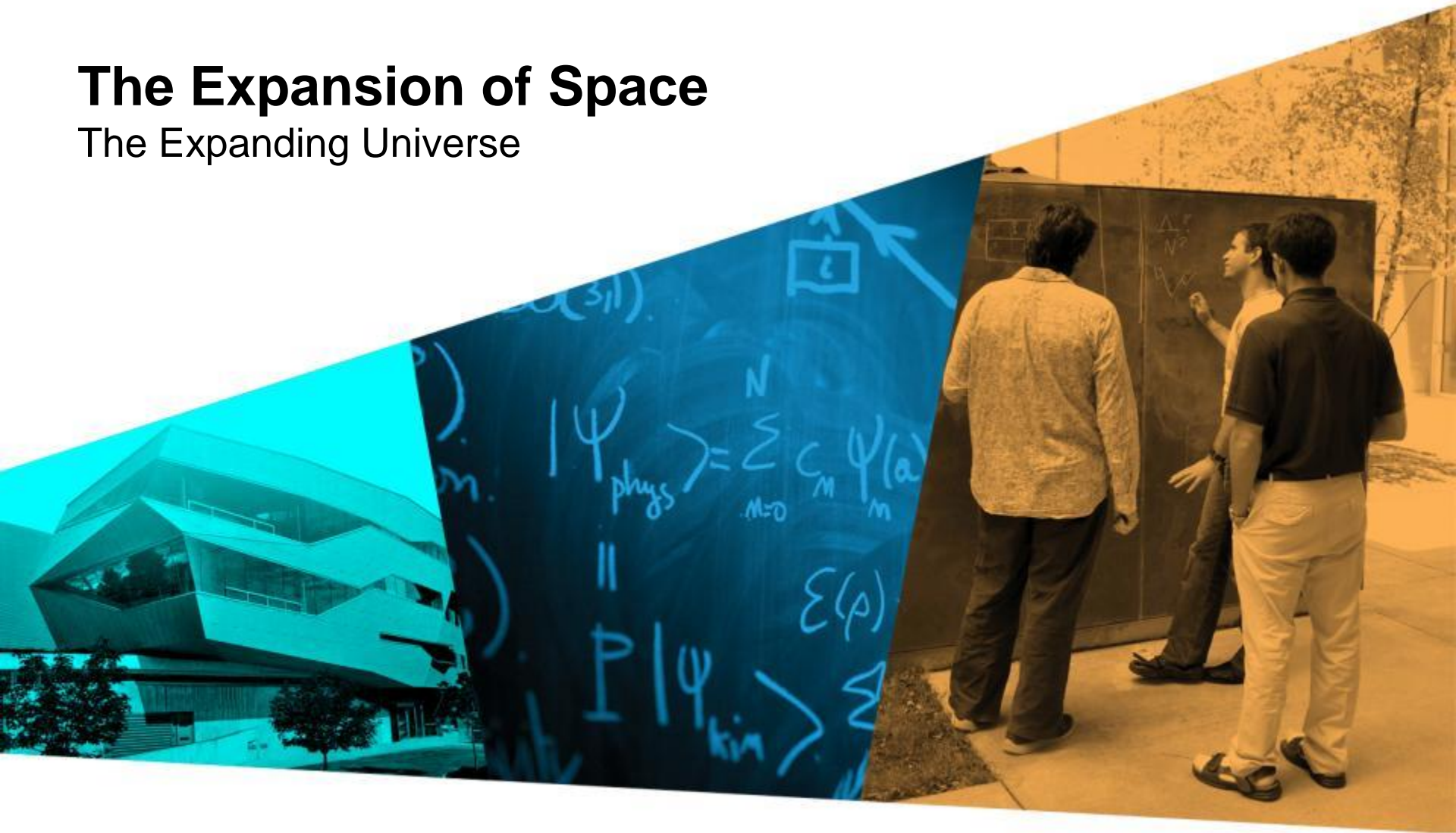


The Expansion of Space

The Expanding Universe



Black Box

Building and Revising Scientific Models



Activity 3: The Expansion of Space

- An activity used to demonstrate the expansion of a one dimensional universe using a simple model of washers attached with elastics
- Students will measure distances between washers in an early and later universe and use guided discovery to confront misconceptions about the expansion of our actual universe

The Expanding Universe

Activity 3

The Expansion of Space

This activity is designed to help students understand the nature of our expanding universe, and how galaxies that are farther from us appear to be moving faster than galaxies that are nearby.


Materials

- different sized washers or paper clips (set of 10 per group)
- elastic bands of identical thickness and different lengths (maximum of 9 per group)
- ruler


Procedure

Part I: Measurements

1. Create a "chain of galaxies" by attaching each galaxy—a washer or a paper clip—to elastic bands. Be sure to use different sizes of washers or paper clips and to vary the distances between the galaxies by using a variety of lengths of elastic bands. Loop the elastics around themselves when attaching them to the washers or paper clips.




2. Each group will determine the distance between galaxies using a different measurement unit, for example, centimeters, inches, floor tiles, inches, feet, or hand lengths.
Unit Choice: _____
3. In a large space, such as a hallway, place your galaxy chain on the floor, leaving it unstretched.
4. Choose your group's home galaxy from your chain, and record in Table 1. Measure the distance from your home galaxy to the other galaxies in your chain. Record your measurements in column 1 of Table 1.



Measure the distance (d_1, d_2, d_3, d_4 , etc.) from your home galaxy to all the other galaxies.

5. Now the universe needs to expand. A group member is positioned at each end of the galaxy chain, then they each pull their washers such that the universe doubles in size (from end to end). A third group member repeats Step 4 and measures the new distances to the galactic neighbours. Record your measurements in column 2 of Table 1.



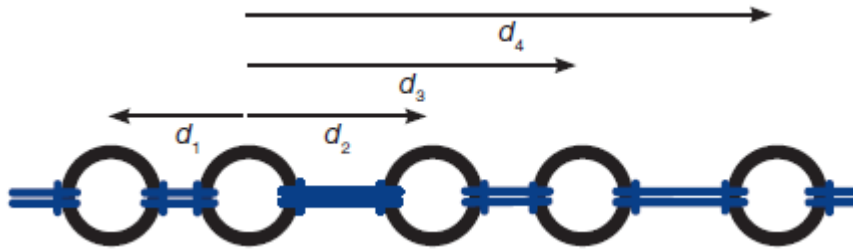
Measure the stretched distance (d'_1, d'_2, d'_3, d'_4 , etc.) from your home galaxy to all the other galaxies.

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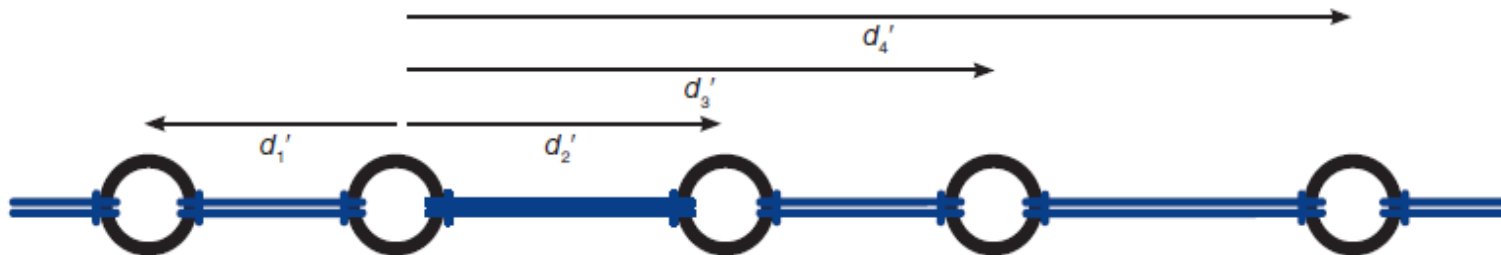


Activity 3: The Expansion of Space

- Early Universe:



- Later Universe:



Activity 3: The Expansion of Space

Misconceptions

- On your white boards, list three misconceptions that your students might believe when thinking about the expansion of space.



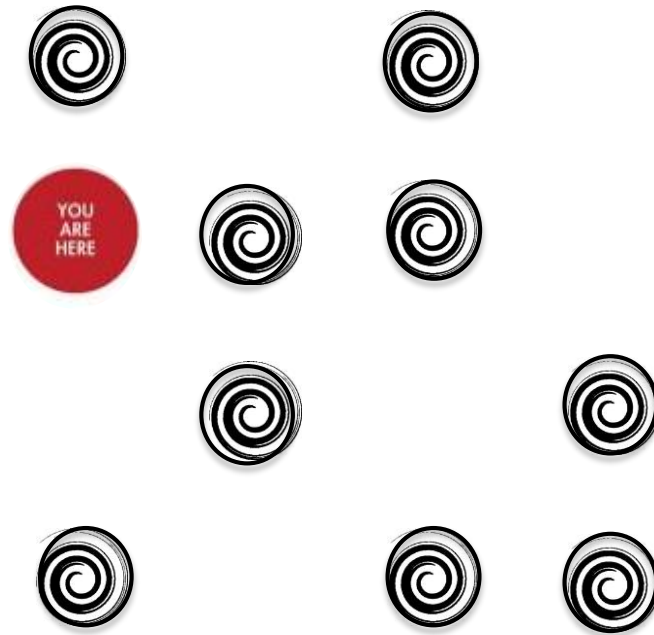
Activity 3: The Expansion of Space

After completing the activity, put yourself in the shoes of the students and answer the inquiry questions listed on the handout.

1. Compare your slope with that of your classmates. What do you notice? What effect does your choice of home galaxy have on the slope?
2. Describe how the positions of the distant galaxies changed compared to the positions of the nearby galaxies. How does your slope reflect this?
3. How would the chain look if the slope value were higher? Lower? How would you describe the universe if the slope were higher? Lower?
4. Comment on the difference in measurement units used. Is one system better than another?
5. If the universe is expanding, why don't the sizes of the galaxies expand as well?



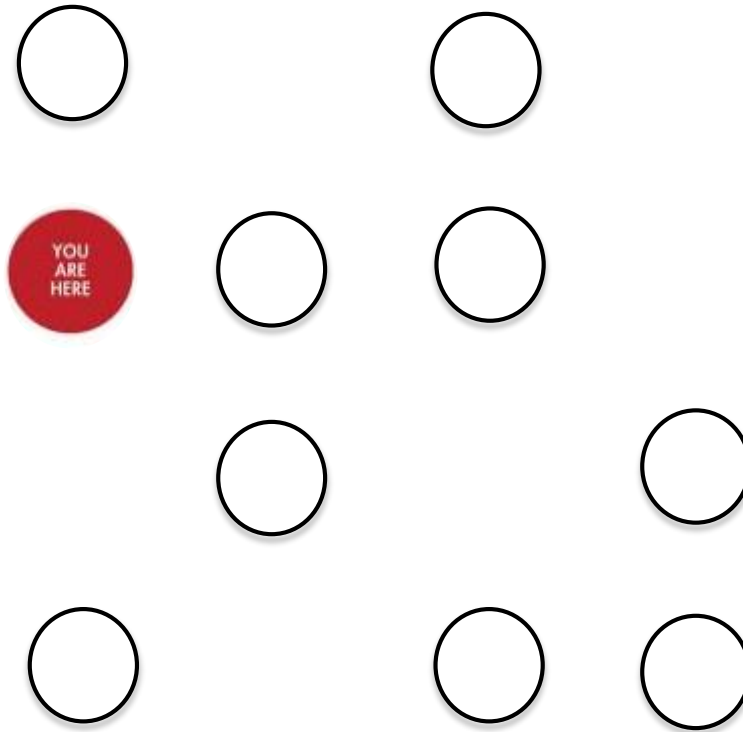
POE: Where is the Centre?



The universe in the past...



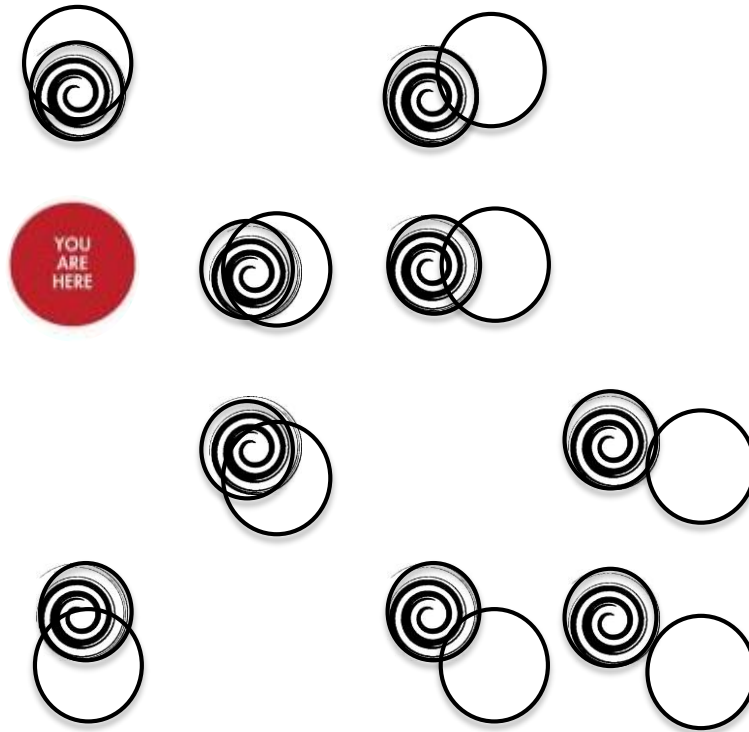
POE: Where is the Centre?



The universe now...



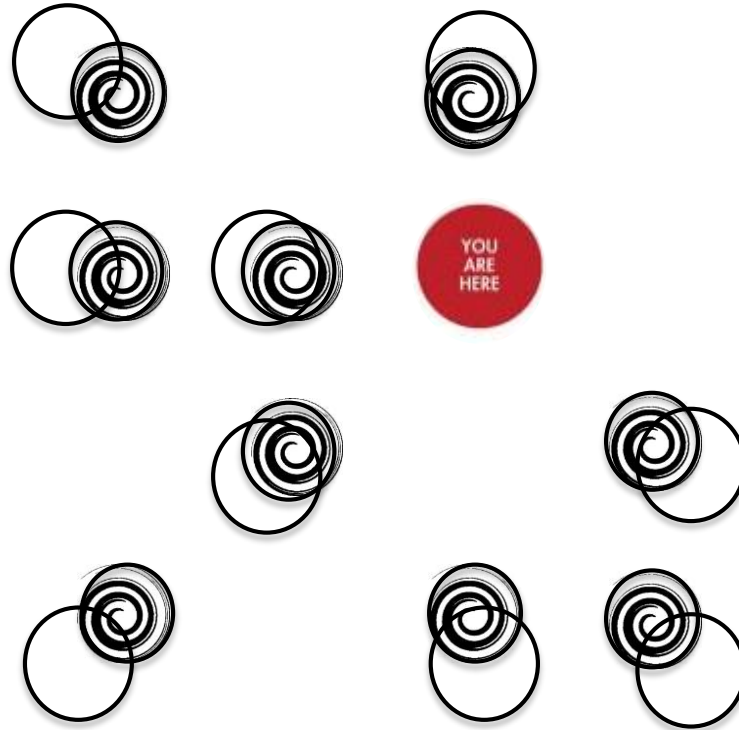
POE: Where is the Centre?



Everything is moving away from us



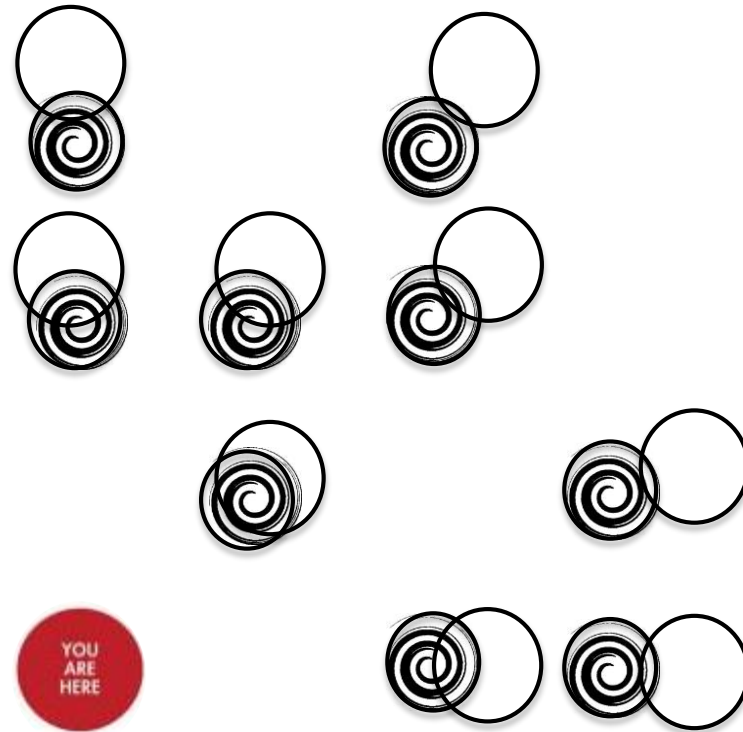
POE: Where is the Centre?



Choose another viewpoint...



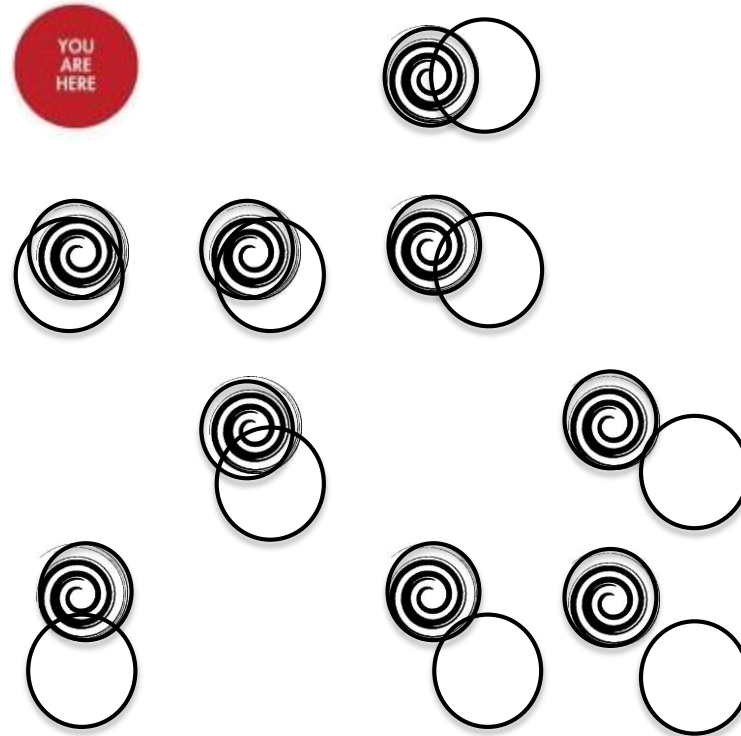
POE: Where is the Centre?



Or another viewpoint...



POE: Where is the Centre?



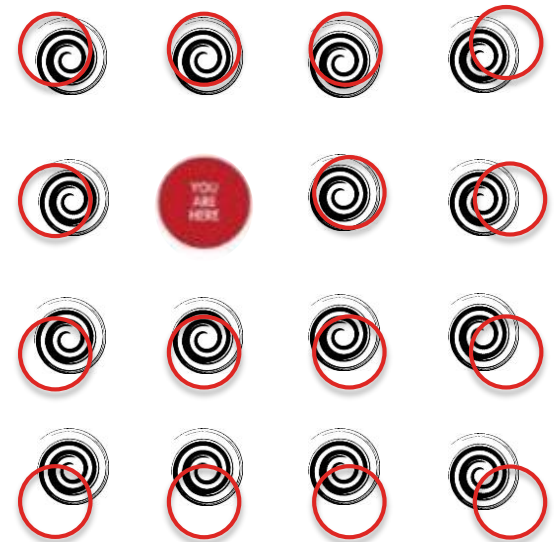
Or another...



POE: Where is the Centre?

It doesn't matter where you are... everything else is moving away from you

There is NO CENTRE!!



Thank You!!

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