



# FACILITATOR GUIDE

## Expanding Universe

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### Learning objectives

Learners engaged in this activity will explore these main ideas:

- Astronomers make observations and use mathematical models to understand how the universe changes.
- Most of the the galaxies we can observe are moving away from each other as the universe expands.
- The beginning of the universe, over 13.8 billion years ago, was like a sudden expansion from a very hot, very dense state.

### Materials

- Measurement board with one-inch concentric rings in alternating colors
- Four-way elastic band attached to the measurement board
- Eight one-inch galaxy buttons (affixed to the elastic band)
- Squeeze clamps (2)
- Sign, sign stand, information sheets, and activity and facilitator guides
- “Tips for Leading Hands-on Activities” sheet

**The Explore Science toolkit comes complete with all necessary materials for this activity.** Materials are also readily available to create or restock activity kits. The galaxy buttons, the board with concentric rings, and the fabric band were custom made for the physical toolkits, but you can recreate the model with your own printed graphics and stitched elastic fabric. Buttons can ordered from online vendors using the provided graphic files. The four-way elastic band is anchored to the board with a nut and bolt. You can reprint the transparency info sheet on most laser printers. All graphic files can be downloaded from [www.nisenet.org](http://www.nisenet.org).

### Safety

The elastic band can snap back if pulled too far and released too quickly. Before beginning the activity, ask participants to gently release the ends of the band back toward the center of the board rather than just letting go. You can model this behavior yourself!

## **Advance preparation**

Before doing this activity, you will need to open the board, lay the elastic bands flat, and attach all eight galaxy buttons onto the elastic band using the white lines as a guide. Each of the four arms gets two buttons. Try to arrange the buttons so that, when unstretched, the inner buttons line up with the third circle, and the outer buttons line up with the sixth circle. Before doing the activity with participants, clamp the measurement board securely to a table using the provided clamps.

## **Notes to the presenter**

The “Are We at the Center of the Universe?” transparency info sheet should be included along with this activity. Together, both models help explain the expansion of the universe and demonstrate that there is no center of the universe. For more about this possible misconception, see the section on difficult concepts below.

The formation of galaxies and the expansion of the universe are not developmentally appropriate concepts for very young children. Encourage children to make observations about how the outer buttons move compared to the inner buttons. You can even focus on manipulating and observing the physical model without the need to connect it to the actual phenomena. Some young children may be excited to show off their new skills of number recognition and counting. Allow them to announce which numbers the galaxy buttons line up with, and count the number of rings each button has moved (rather than adding and subtracting, which are skills they may not have yet acquired). With some guided questioning, they may be able to notice that the outer buttons move further than the inner buttons, though may not understand the mathematical relationship.

## **Conversational prompts**

The “Raisin Bread Universe Model” info sheet provides a useful analogy for how we think the universe is expanding. Scientists use models to help explain and understand phenomena they cannot always directly observe. These models help scientists break down a complex problem into smaller chunks that can be tested through experiments and collecting data. Models are not always correct, and scientists often disagree about which model is better. Invite participants to think about other analogies for how the universe is expanding.

## **Difficult concepts**

The stretchy bands are a simple model for demonstrating the expanding universe. However, like many models, the construction of this model is incomplete and can lead to the false impression that there is a center of the universe. This activity includes an information sheet with a transparency overlay to address this difficult concept. It’s important to share this resource with participants as they complete this activity.

While the “Big Bang” is a common phrase used by science writers to refer to the creation of space when the universe began, this event was not an explosion at a particular point in space. The expansion occurred everywhere, all at once, about 13.8 billion years ago. In the distant past, the universe was much more dense and hot, and it

has been expanding and cooling ever since. The analogy of expanding baking raisin bread is a much more accurate model for the expanding universe than a firecracker-like explosion that expands from one point into three-dimensional space.

The objects we observe today in the universe were created gradually and in phases over long periods of time. First, subatomic particles were created, followed by atoms and molecules, and finally larger space objects and systems like planets, stars, and galaxies. It is important to remember that galaxies, stars, and our solar system were not fully formed immediately after the Big Bang. These space objects and systems change over time even today, and they were not flung out whole in the brief chaotic moments early in the history of the universe.

The universe is not expanding into something else. Space itself is expanding.

### Staff training resources

Refer to the “Tips for Leading Hands-on Activities” sheet in your activity materials.

- An activity training video is available at [vimeo.com/304240053](https://vimeo.com/304240053)
- A content training video is available at [vimeo.com/304239551](https://vimeo.com/304239551)
- Additional training videos on misconceptions and facilitation can be found at [vimeo.com/album/4249834](https://vimeo.com/album/4249834)
- The NISE Network has a curated list of programs, media, and professional development resources that directly relate to the toolkit. These resources can be viewed and downloaded from [www.nisenet.org/earthspacekitextensions](http://www.nisenet.org/earthspacekitextensions).

### Credits and rights

This activity was developed for the NISE Network by the Science Museum of Minnesota and the Sciencenter. The transparency overlay info sheet in this activity was adapted from No Edge, No Center educational resources, developed by Sonoma State University. Retrieved from: [https://universe.sonoma.edu/activities/no\\_edges.html](https://universe.sonoma.edu/activities/no_edges.html).

Image of M96 Galaxy courtesy NASA/ESA/ Hubble, R.

Artist’s impression of Hubble over Earth courtesy NASA/ ESA



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