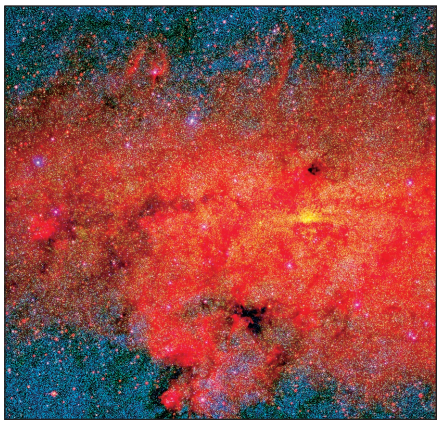
Build your own Galaxy

Introduction

Galaxies come in many shapes and sizes. Our Milky Way is a spiral galaxy, which looks like a pinwheel with arms of stars, gas, and dust. You can make your own Milky Way galaxy with materials you can find at a craft store. Before you begin this activity, review the section *Galaxies: Cities of Stars* and look for key information about our galaxy.



The view toward the center of the Milky Way

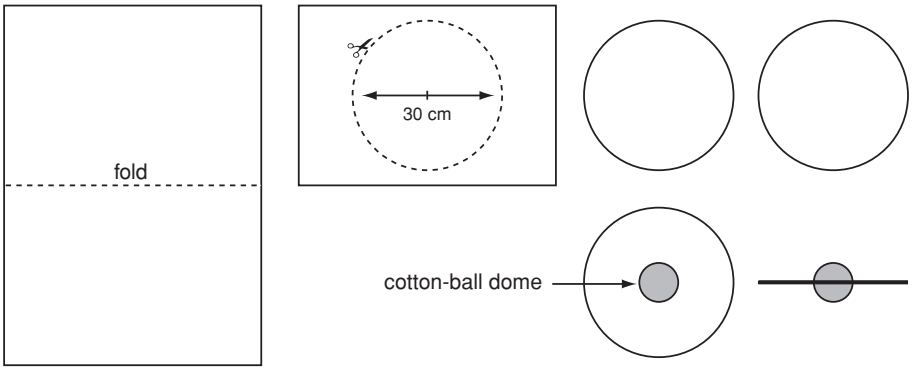
The Milky Way is a huge galaxy. For the 30-centimeter model, each centimeter represents about 3,300 light-years. The Sun is about 27,000 light-years from the center of the Milky Way. In your model, that's about halfway out from the center (8 cm or 3.2 in). Most of the stars you can see in the night sky are within one cm (0.4 in) of the Sun in your model. Our solar system is too small to see on the scale model of our galaxy. If our solar system were the size of a quarter, our galaxy would be almost the size of the United States.

Materials

Bag of cotton balls
Half bag of polyester fabric batting
Glue (white Elmer's glue)
String or yarn
Pencil
Red, blue, gold, and silver glitter

How to build your model

Your model can be as big (or small) as you like, but for convenience let's build a model 30 centimeters (12 inches) in diameter. You can scale it up or down to whatever size you wish. Gather materials at your favorite craft store.



Instructions

- Fold the black poster board in half, and trace a circle 30 centimeters (12 inches) wide.
- Cut out the circle. You should end up with two circles.
- Glue the two circles together, flat sides touching like a stack of pancakes.
- Let the glue set for about an hour.
- Build a dome of cotton balls in the center of the poster board circle. Apply dots of glue to the cotton balls to hold them together, and secure them to the poster board. The dome should be about 8 cm (3.2 in) across and 4 cm (1.6 in) high. Repeat on the other side of the poster board circle.
- Pull out the cotton into streams and spiral them around the cotton-ball dome.
- Dribble glue on the arms and sprinkle glitter (blue and silver) on the glue to represent newly forming stars.
- Dribble glue all over the poster board and foam ball, and sprinkle just this glue with gold and red glitter to represent older stars.
- You can add to your model by marking the position of our Sun with a "You Are Here" or "Home Sweet Home" sign. Mark the Sun 8 cm (3.2 in) from the center inside one of the spiral arms.
- You can decorate both sides of your galaxy model. Wait until all the glue has dried on the first side before decorating the second side.
- Punch a hole in your model, and thread it with string. Hang your model from the ceiling.

2MASS/UMASS/IPAC-CALTECH/NASA/NSF; OPPOSITE: NOAO/AURA/NSF (2); ADAM BLOCK/NOAO/AURA/NSF

Some of the materials represent major characteristics of our galaxy:

Central bulge: *the cotton-ball dome.* The rounded structure in the central 6,400 light-years of the galaxy's center is what astronomers call the bulge of our galaxy.

Disk: *foam batting on the poster board.* The disk of stars in our galaxy contains gas, dust, and stars. Generally, it is flat like the brim of a wide hat. Astronomers estimate that the galaxy's disk is about 100,000 light-years in diameter.

Stars: *glitter.* The hottest and brightest stars are blue and white. But these stars live short lives — only ten million to a few hundred million years — and spend their whole lives close to where they were born in the spiral arms. Older stars found in the bulge and disk may be yellow, like the Sun, or red.

Extending your knowledge about galaxies

Stars are easy to see with your eyes, but lots of hydrogen clumped into cool gas clouds also orbits the galaxy. Astronomers can see these clouds because they emit radio waves at a specific wavelength. Using radio telescopes, astronomers map out these hydrogen clouds. Huge clumps of hydrogen emit radio waves at a wavelength of 21 centimeters (your microwave oven cooks food by emitting strong radio waves, called microwaves, at a 12-centimeter wavelength). Astronomers have detected hydrogen far beyond the luminous stars of our galaxy. In your model, the hydrogen clouds would extend an additional nine centimeters from the edge of the disk. In real space, that's an extra 28,000 light-years!

Surrounding our galaxy is a halo of scattered stars and globular star clusters. These stars are much older than the stars in the disk. Some travel up or down through the disk. Their largest concentration is near the bulge.

Your model can help you learn more about galaxies and how they are distributed in intergalactic space. Folks in the southern hemisphere can see two satellite galaxies close to the Milky Way. These are called the Large Magellanic Cloud and the Small Magellanic Cloud. On an intergalactic scale they are very close. The Large Magllanic Cloud is 165,000 light-years away, while the Small Magellanic Cloud is farther at 200,000 light-years. On the scale of a 30-cm size Milky Way, these two smaller satellite galaxies would be about 50 cm and 60 cm away. You can make model satellite galaxies using individual cotton balls. Tease the cotton balls out to make a messy blob, then add glue and glitter.

On a grander scale is the Andromeda galaxy, a mere 2.5 million light-years from our galaxy. That sounds like a long distance, but compared to the size of the Milky Way, Andromeda is a close neighbor. If you made a second galaxy model representing Andromeda, and placed it about 25 Milky Way diameters away (7.5 meters or 25 feet), that would be the scale separation between these two giant spirals. So intergalactic space is big, but for galaxies it's rather crowded. For this reason, galaxies can collide and merge to form bigger galaxies.

Small (top) and Large Magellanic Clouds

The Andromeda galaxy, M31

Use your model while you stargaze

You can use your model to help you understand our place in the galaxy. When you look toward the stars in the constellation Sagittarius, you are looking toward the center of our galaxy. Line up your model so that its center lines up with Sagittarius. Then align the disk of your model with the Milky Way in the sky. Now you can imagine where we are inside our galaxy.