

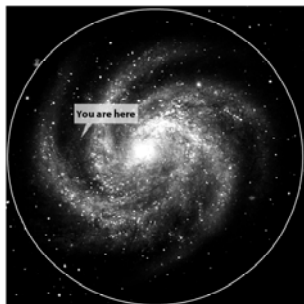


A Universe of Galaxies

How is the Universe Structured?

About the Activity

Use this model of the Milky Way and other galaxies to indicate relative distances to other galaxies.



Topics Covered

- How far away are the other galaxies?
- How far to the limit of the observable universe?
- Where are we located with respect to other galaxies we see in the telescope?

To Print:

- Visitor Handouts (included below)
- CD label document (below)
 - (Optional) The Galaxy CD pages fit Avery 5692 and 8692. These labels simply peel off and attach to the CD.
 - You may want to print more than one of the Milky Way CD Labels for telescope operators to use as a reference.

Participants

This activity can be used with the general public at a star party as well as in a classroom or with youth groups ages 10 and up.

Location and Timing

You will need a large area, e.g. parking lot, playground, or park. The presentation takes about 15 minutes and can be followed up by viewing through the telescope.

Materials Needed

- Telescopes
- 15+ used CDs
- Scissors
- Glue stick
- (Optional) Cotton Ball

Included in This Activity

Preparation Instructions
Detailed Activity Description
Helpful Hints
Background Information
Visitor Handouts



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Additional astronomy activities can be found here: <http://nightsky.jpl.nasa.gov>



Preparation Instructions

- Assemble the galaxy CDs. Cut out the CD labels and attach them to the used CDs. Each page contains two sides of the same disk.
- You may want to pull off a small piece of cotton to glue to the center of the Milky Way CD – to represent the central bulge.
- You may want to add club information on the Milky Way Galaxy (“You are here”) CD handout sheet.

For a Star Party

- Each participating amateur astronomer may pick any object(s) he or she wishes to show and that his or her telescope is capable of viewing.
- For those amateur astronomers who wish to use the Milky Way CD as a reference, make sure each person has one or the whole set

Detailed Activity Description

At the Telescope:

One of the CDs shows an image of M74, which represents about what our Milky Way Galaxy would look like if we could go far out in space and take a photo of it. The arrow on the CD marks the approximate position of our star, the Sun. The reverse shows the relative distances to other galaxies if our Milky Way was shrunk down to the size of the CD.

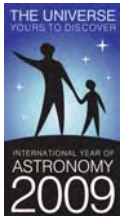
You can pull out the Milky Way CD at any time when showing people a variety of objects to give them the sense of distance in relation to our own place in the Galaxy.

For example when pointing out M31, from our position on the Milky Way CD, M31 would be 2.3 meters away. Other galaxies like those listed on the back of the CD are at even greater distances. The limit of the observable universe is out approximately 14 km on this scale.

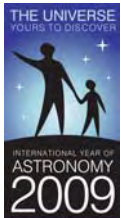
When showing objects within our Galaxy, you can say that the object is on the CD within a few centimeters of our position (marked by the arrow).



Leader's Role	Participants' role (expected)
<p>Introduction: Introduce the activity and explain to the visitors what to expect. You can use the following script, if you wish:</p> <p><u>To Say:</u> What's the difference between the Solar System, the Galaxy, and the universe? (Have a discussion – make sure most people understand the difference – for more details, see the “Our Place in our Galaxy” activity).</p> <p>If we shrink our Galaxy – the Milky Way Galaxy – down to the size of this CD, how far away do you suppose the rest of the galaxies in our universe are?</p> <p>Who wants to be the Milky Way Galaxy? Who wants to be [other] galaxy?</p> <p><u>To Do:</u> Pass out galaxies or have someone pass them out. Don't pass out the Quasar or the Hubble Deep Field. With the Milky Way Galaxy person in the middle, distribute the others around the Milky Way and have them pace off the distance to each of their galaxies.</p>	<p>Discuss ideas.</p> <p>Take galaxies and go out to appropriate distances.</p>



Leader's Role	Participants' role (expected)
<p><u>To Say:</u> Who has a galaxy within 3 meters of the Milky Way? You are in our local group of galaxies – living in the same yard. Who has galaxies within 100 meters? Those are our neighbor galaxies – in the same block.</p> <p>So here are just a few of the billions of galaxies in our universe. These are all fairly close to us. These are galaxies we are able to see in the telescopes you'll be looking through tonight. Now here's one that is over 2 billion light years away [the quasar]. On this scale, it is 2.5 kilometers away. (Hand it to someone) Would you like to take this one to where it belongs?</p> <p>(Hold up the Hubble Deep Field CD) And this is an image of the galaxies in the Hubble Deep Field – some of these galaxies are as far away as our best telescopes can see – over 12 billion light years away! Many of these galaxies are near the limit of the observable universe, which is 13.7 billion light years away. How far away should these galaxies be placed? (Turn over the CD and show the audience the distance on the other side) About 14 kilometers. Who wants to take this one? That would be about as far away as _____ (Pick a city or landmark about 14 km away from your location.)</p> <p>At least 200 billion galaxies are within the observable universe. Imagine CDs distributed all around us – out to 13.7 km away in any direction.</p>	<p>Respond and walk out to correct distance.</p>



Leader's Role	Participants' role (expected)
<p><u>To Say:</u> So, to review: On the scale we've built, how big is our Galaxy, the Milky Way? (Hold up the Milky Way CD)</p> <p>And from how far away can we see light from other galaxies? (Hold up the CD with the Hubble Deep Field on it)</p> <p>NASA sponsors a series of missions to find out more about the very early universe and how galaxies formed within it.</p> <p>So enjoy your evening looking through the telescopes at all the wonderful things within our own Galaxy and looking at some of these galaxies outside of our own!</p>	<p>The size of a CD</p> <p>About 14 kilometers away</p>

Presentation Tips

Shapes of Galaxies:

Of course, not all galaxies are spirals. Some are shaped like giant balls of cotton: ellipticals. Some have irregular shapes – these are appropriately called “irregulars”.

Judge if your audience is ready to absorb more information– most need to digest what they have just learned before moving on to more. Each galaxy CD describes the type of galaxy, its approximate shape and size compared to the Milky Way CD.

Our Place in the Universe:

When you say that the observable universe extends 13.7 kilometers in any direction, your audience may have the mistaken impression that we are the center of the universe. One way to answer this is to say:

No matter which of these galaxies you might happen to live in, you would still only be able to see light coming from galaxies no more distant than about 13.7 billion light years – back to just after the Big Bang. Or 13.7 kilometers on this scale. So there is no “center” to the universe. Every galaxy will appear from its own perspective to be at the “center”.



Helpful Hints

For online access to the booklet “how big is our universe?” go to:

<http://cfa-www.harvard.edu/seuforum/howfar/index.html>

After you enter the website, click on “download pdf” or “print-friendly pdf” to download a copy of the booklet.

For a tour of Our Place in Space:

http://cfa-www.harvard.edu/seuforum/opis_tour_earth.htm

Background Information

When we show people galaxies through the telescope or describe our own galaxy, it is often difficult for people to get a sense of the distances involved. This activity provides visual props to help to clarify the scale of what you are showing.

The individual stars in each of the photographs of a galaxy can be confusing to some people. Explain that the stars in the photos are here in our own galaxy – we are looking out through the stars in our Galaxy to other galaxies beyond our own – a bit like standing in a swarm of flies and looking out through them to a house several yards away. Or looking out through a dirty, speckled window to the scenery outside.

We cannot see our own star, the Sun, on the Milky Way Galaxy CD. It would be like trying to pick out your porch light on a satellite photo of the USA at night.



Credit: NASA



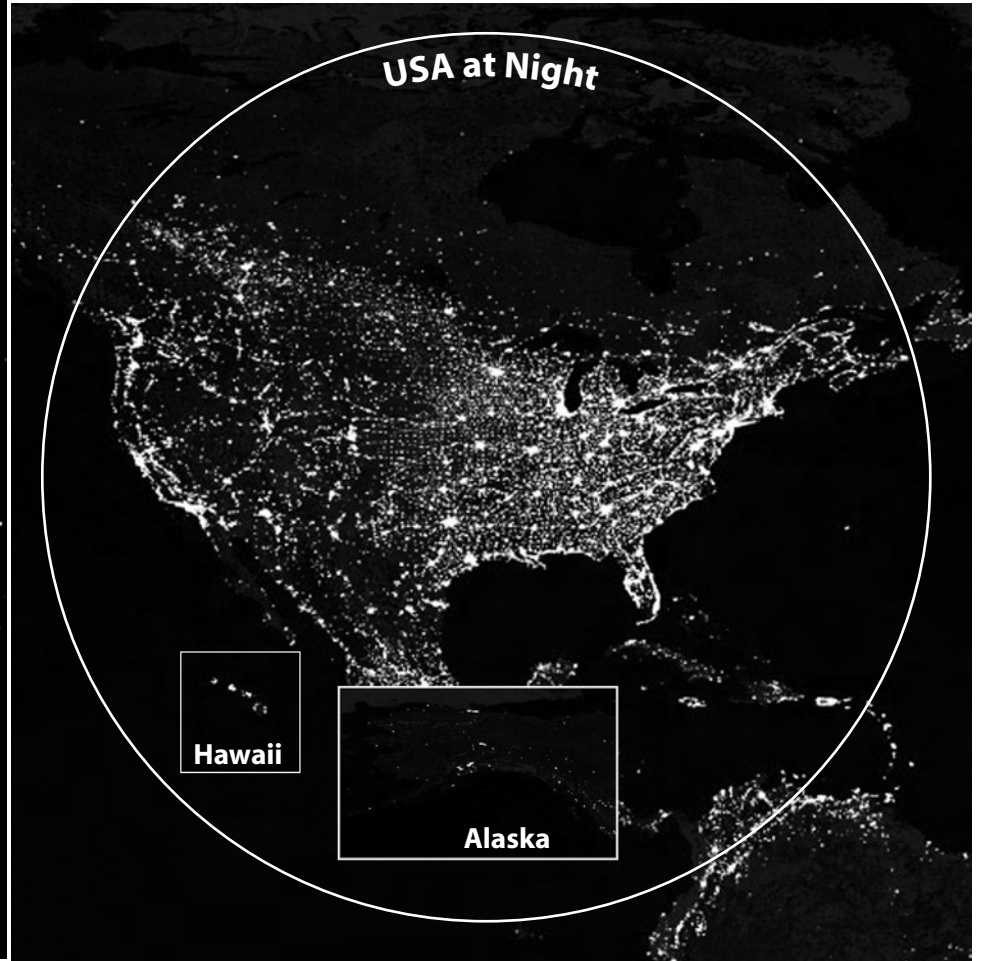
A UNIVERSE OF GALAXIES

Cut out each circle and glue the "FRONT" to the label side of a used CD.

Glue the "BACK" to the other side of the CD.



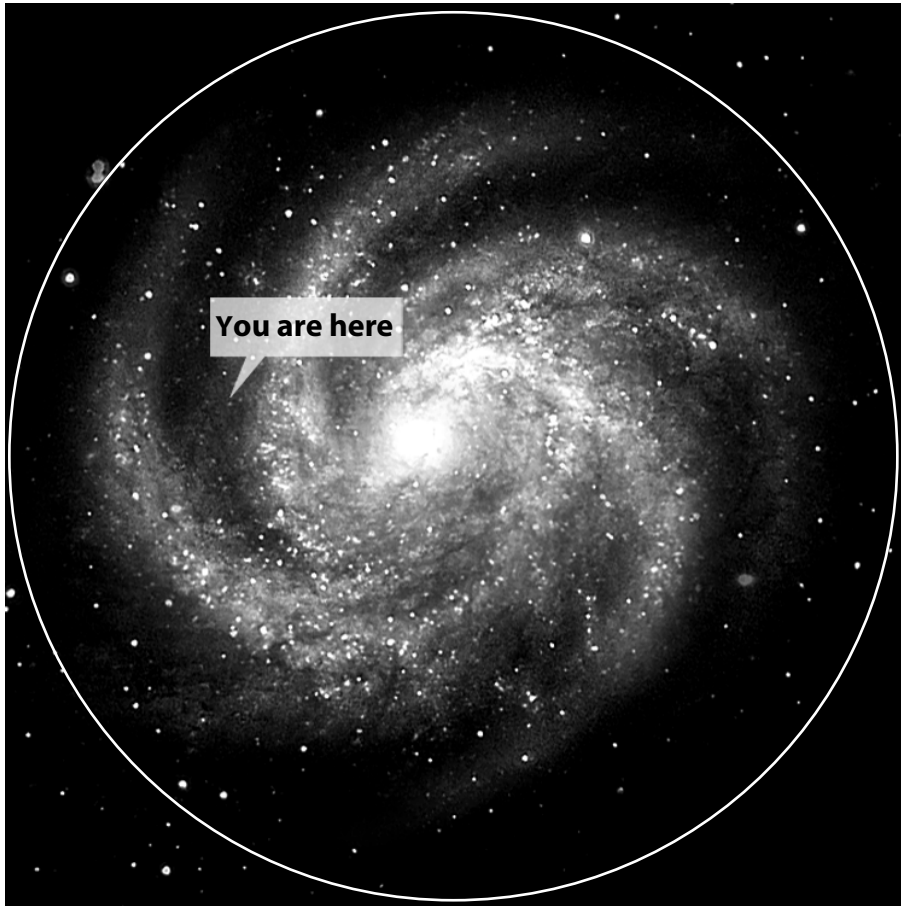
FRONT



BACK

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FRONT

A UNIVERSE OF GALAXIES

Milky Way Galaxy

YOU ARE HERE

- We live about halfway out from the center of our galaxy
- The Sun is an average star. The Milky Way Galaxy, which is 100,000 light years across, contains about 200 billion other stars.
- The ratio of our galaxy's width to thickness is almost the same as this CD approximately 100:1

Scale: 1 Million Light Years = 1 meter

Using this CD as our Galaxy, other galaxies would be at the following approximate distances from us:

M31: 2.3 m	M33: 2.4 m	M81: 12 m
NGC4565: 31 m	M66: 35 m	M51: 37 m
M104: 50 m	M87: 60 m	3C273: 2.5 km

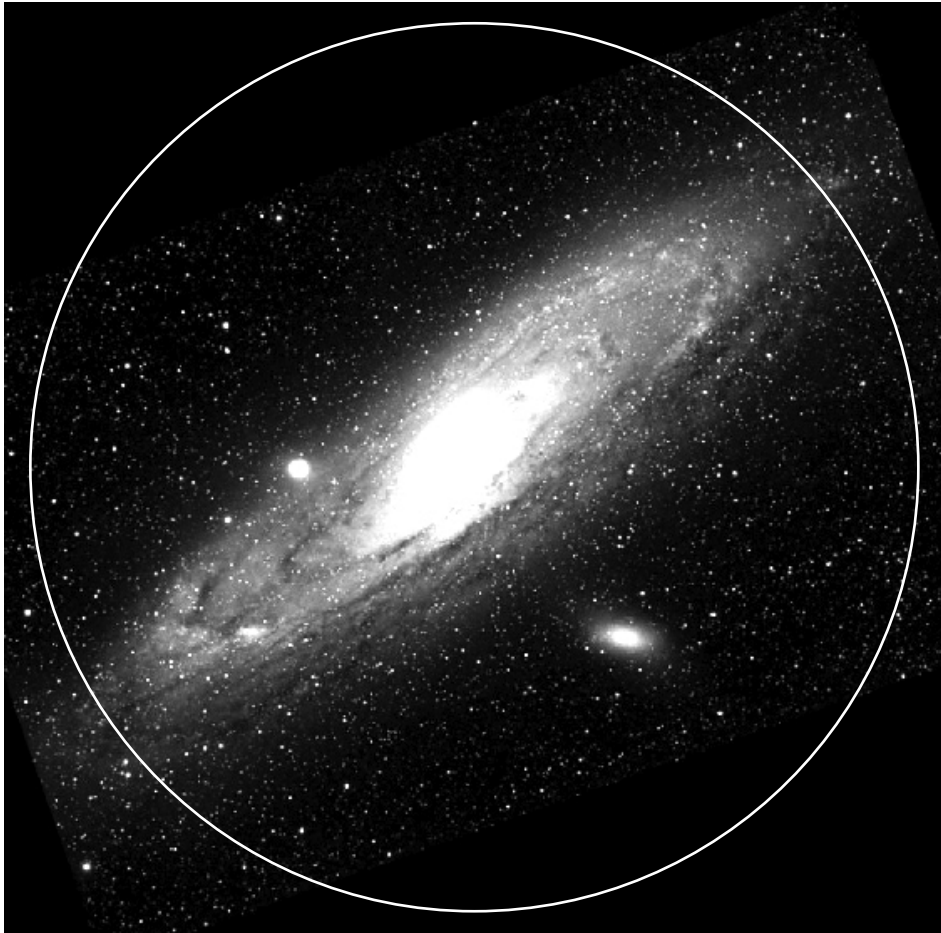
Hubble Deep Field
(representing the limit of observable universe): 13.7 km

Image Credit: NASA
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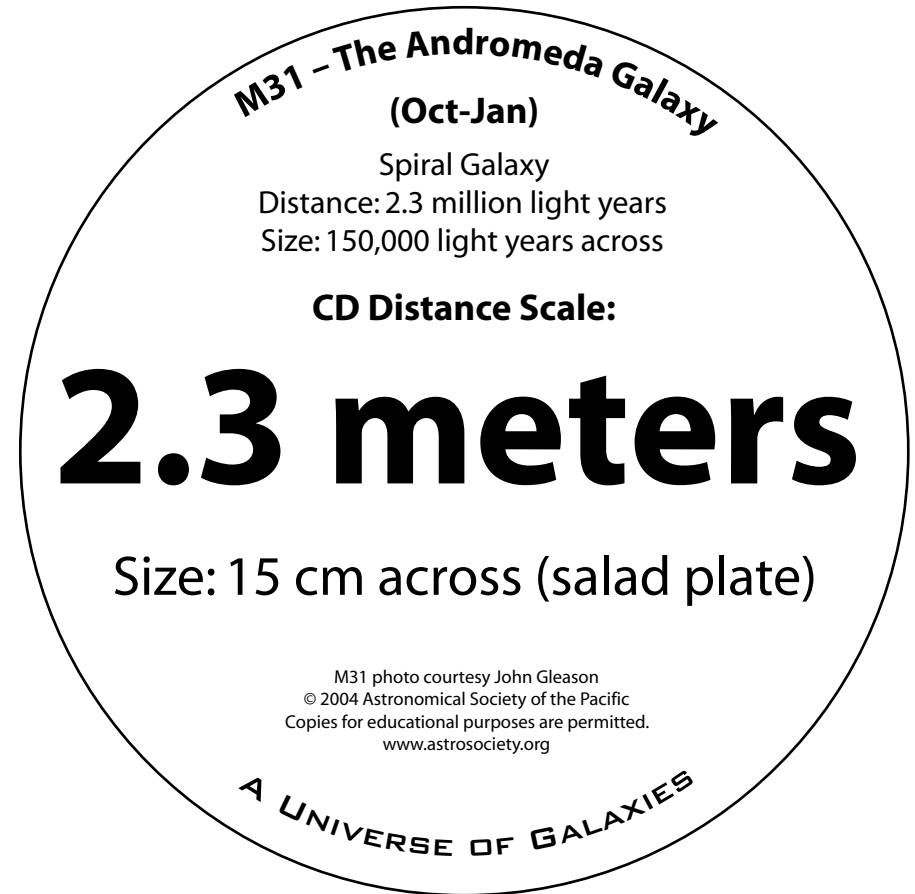
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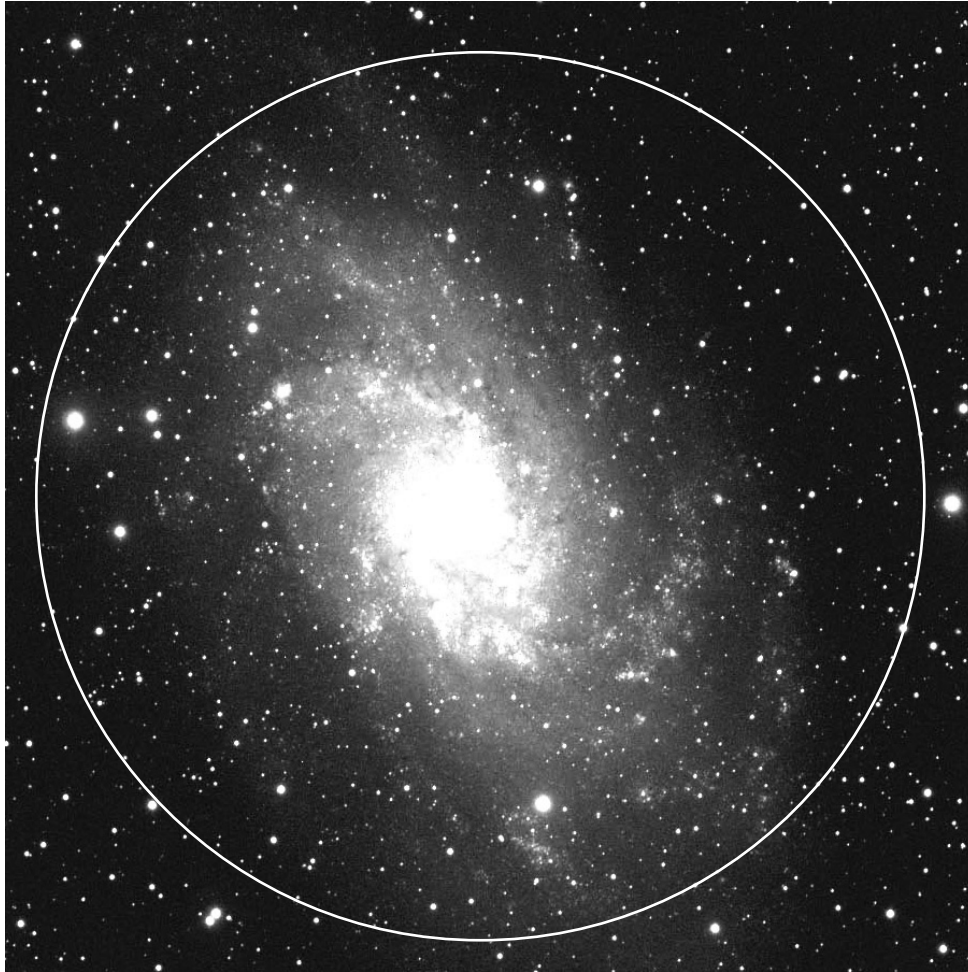
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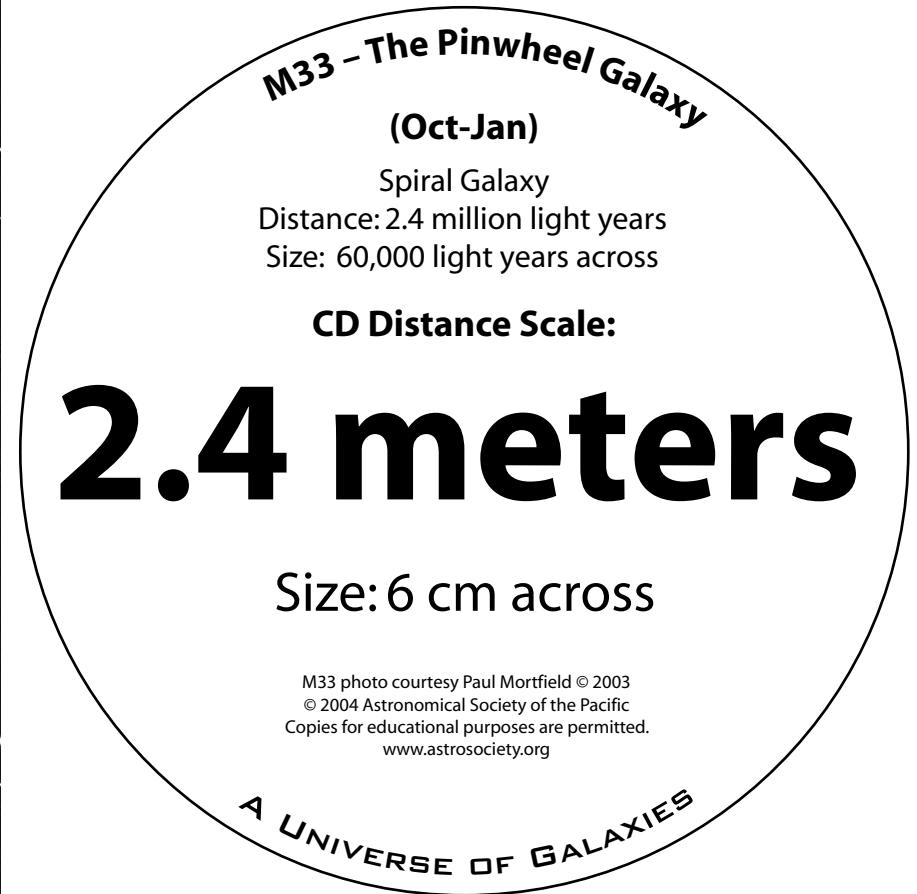
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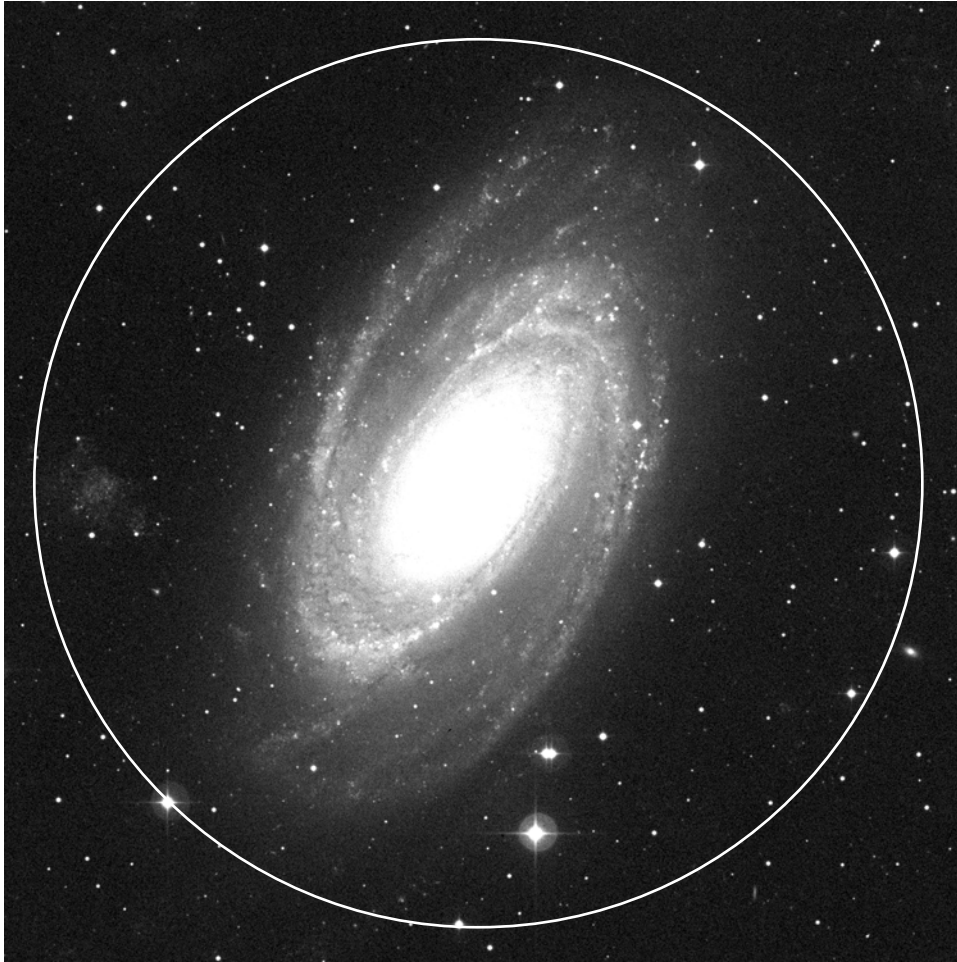
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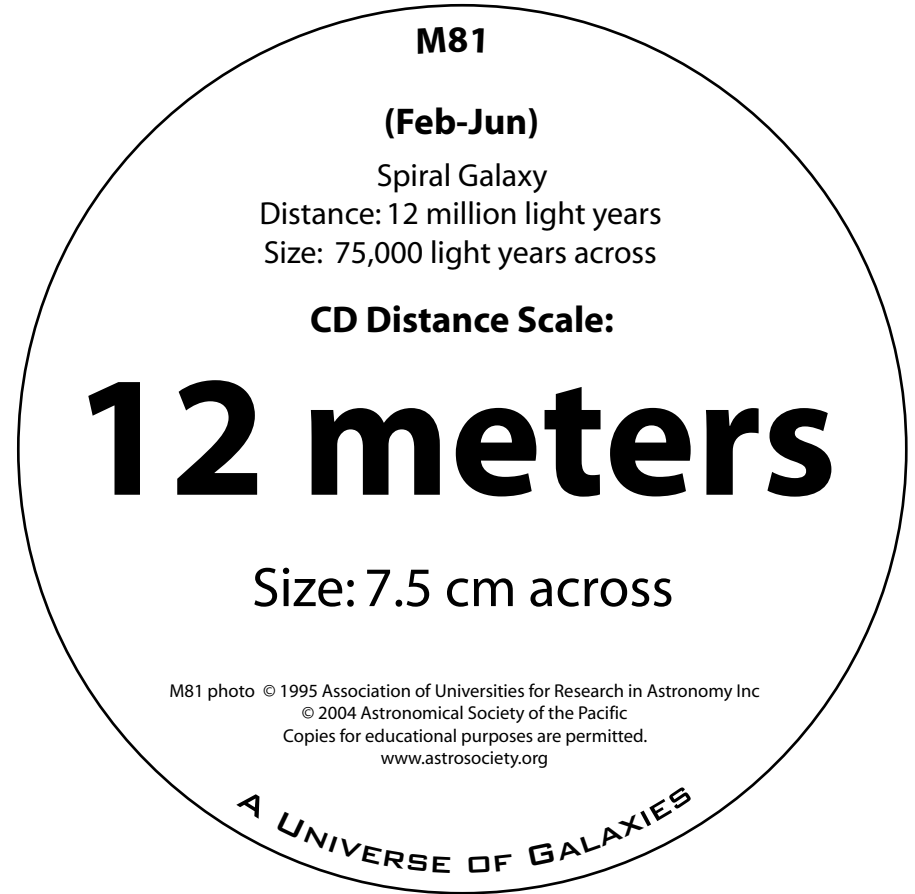
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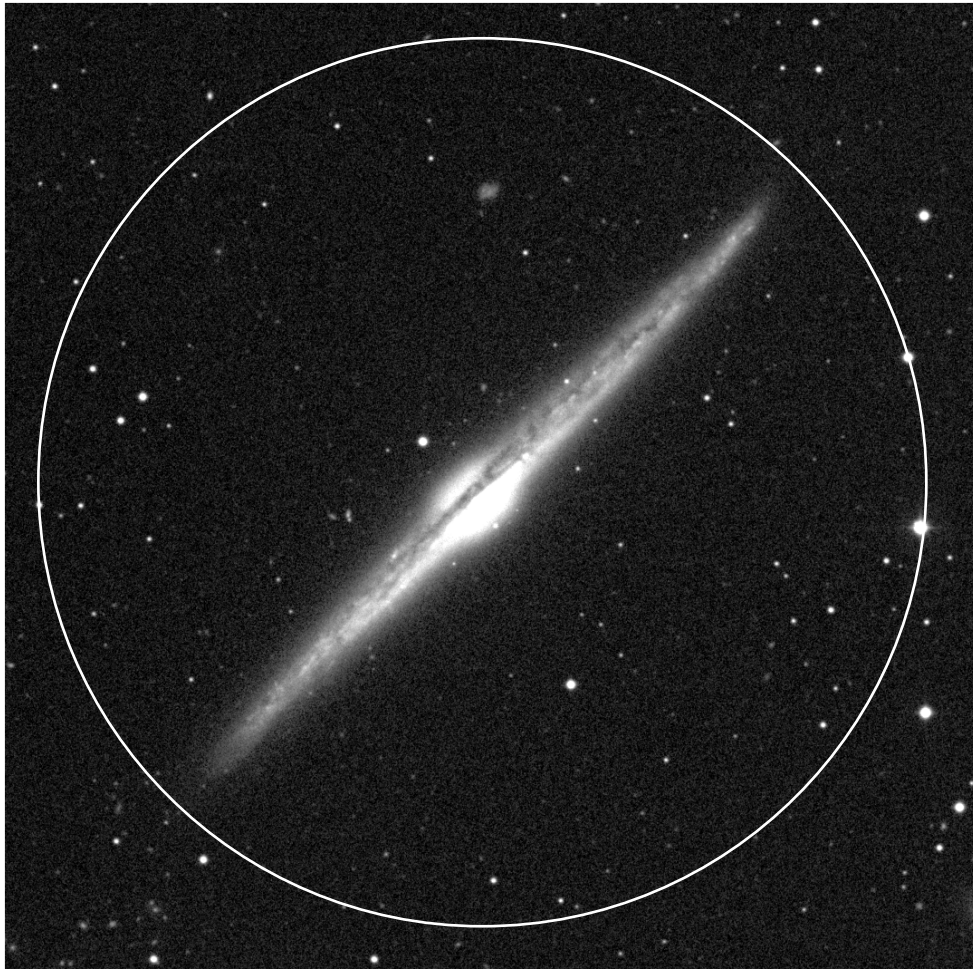
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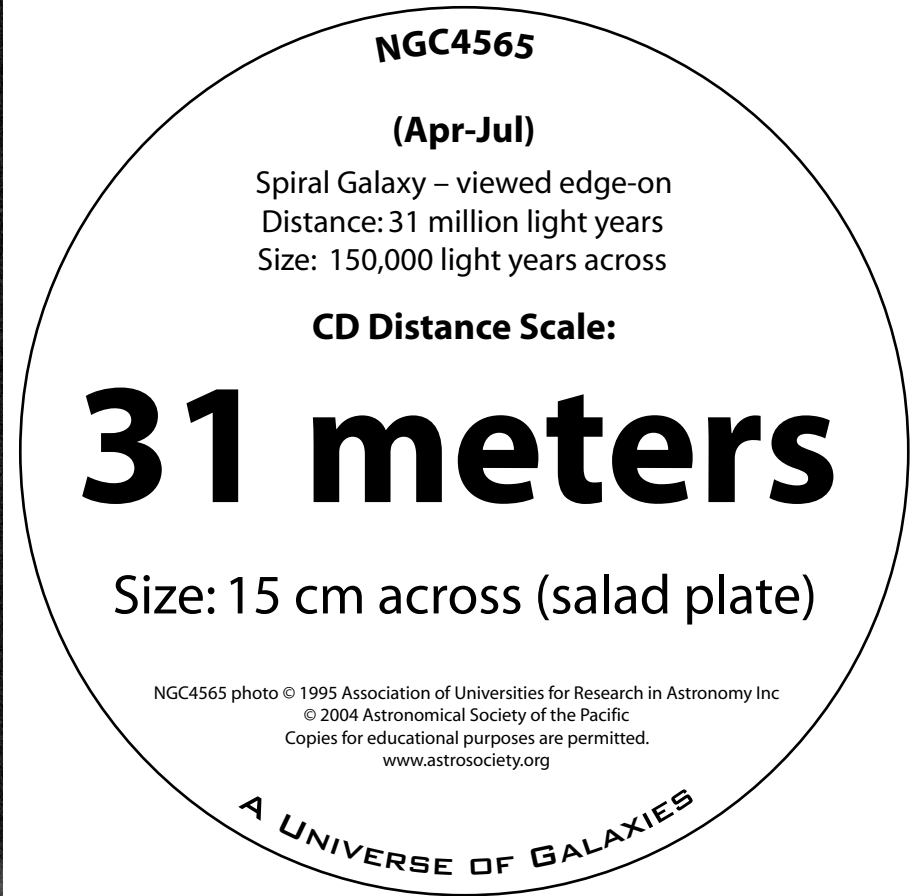
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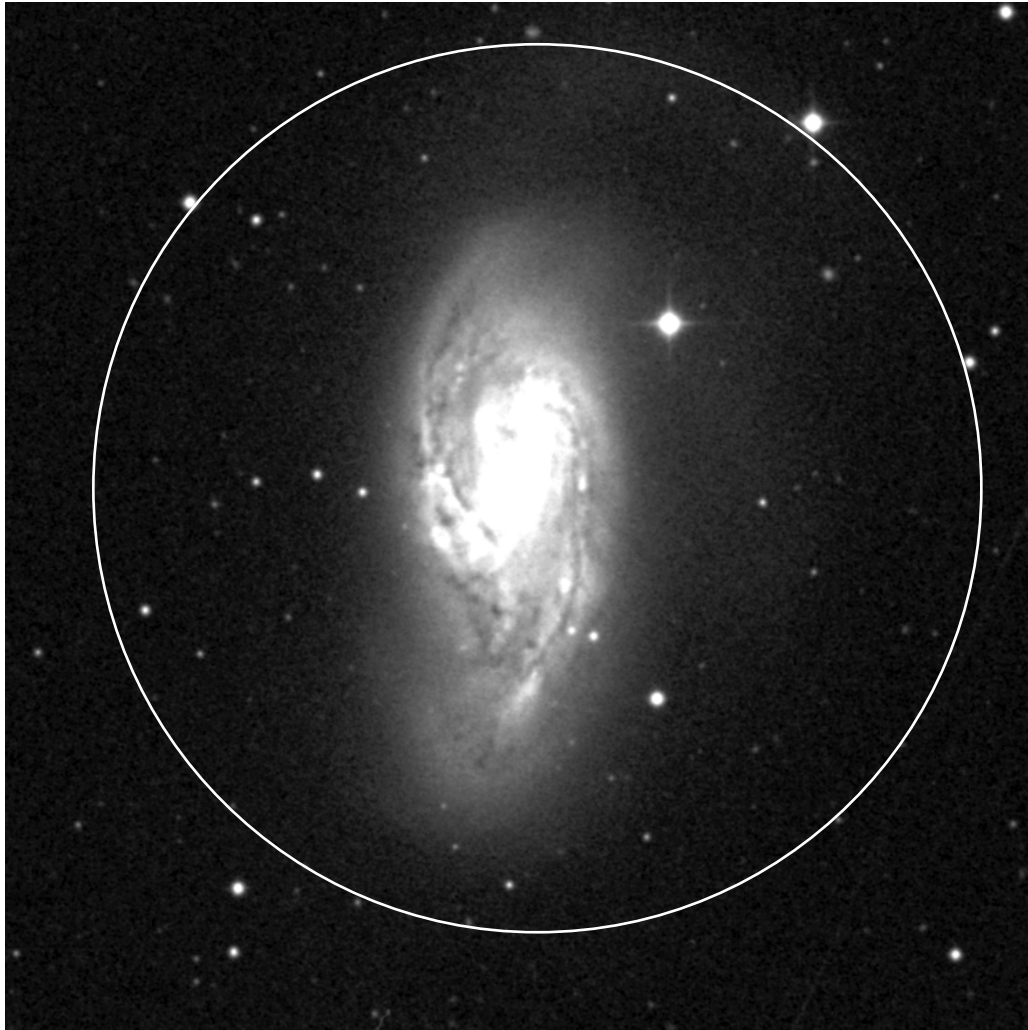
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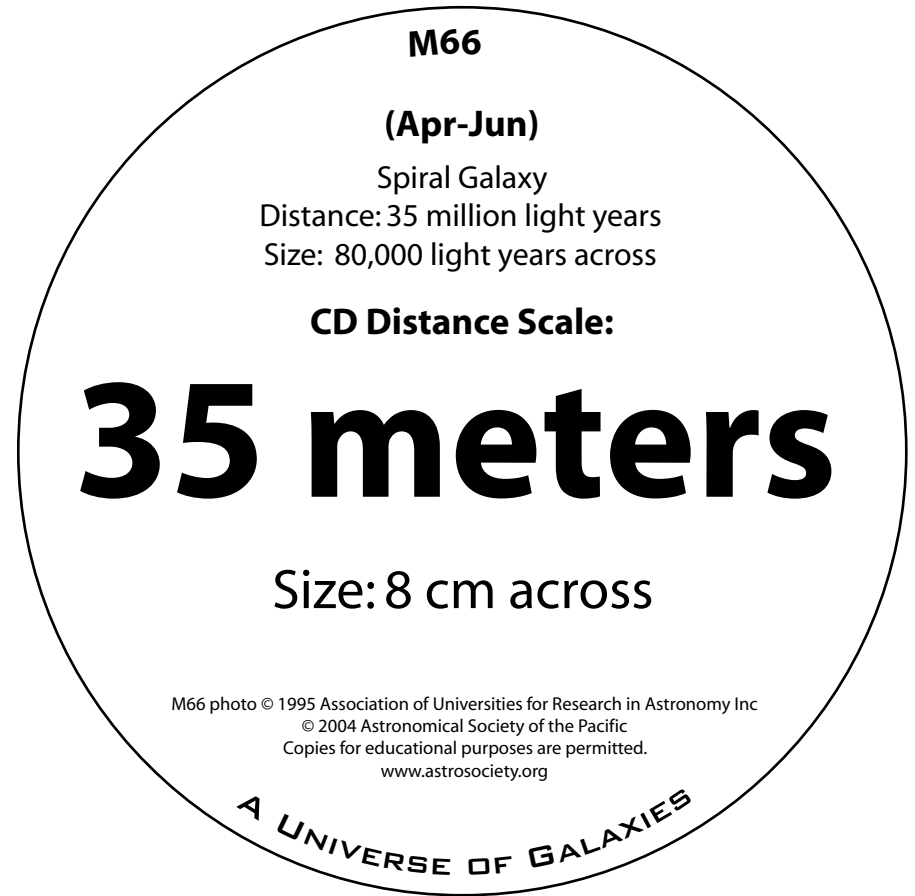
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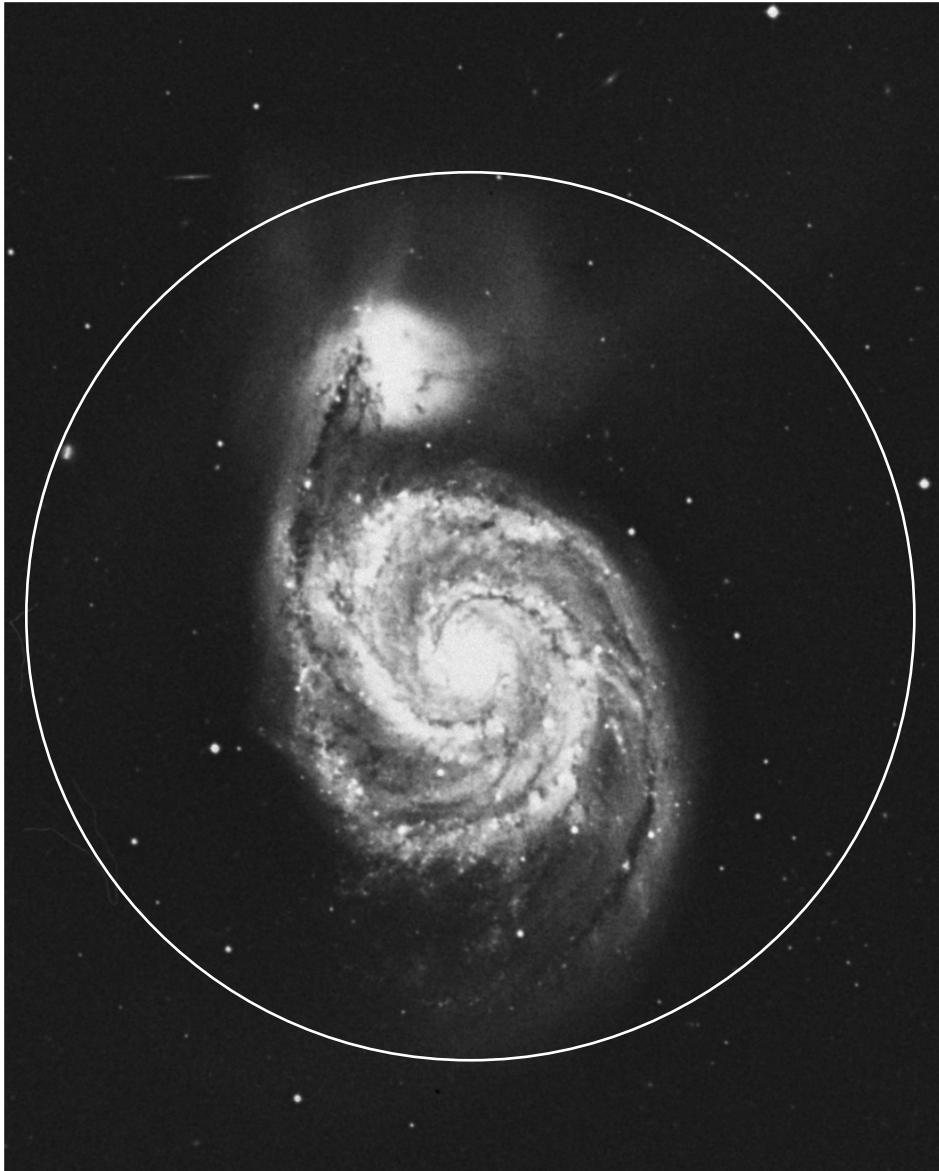
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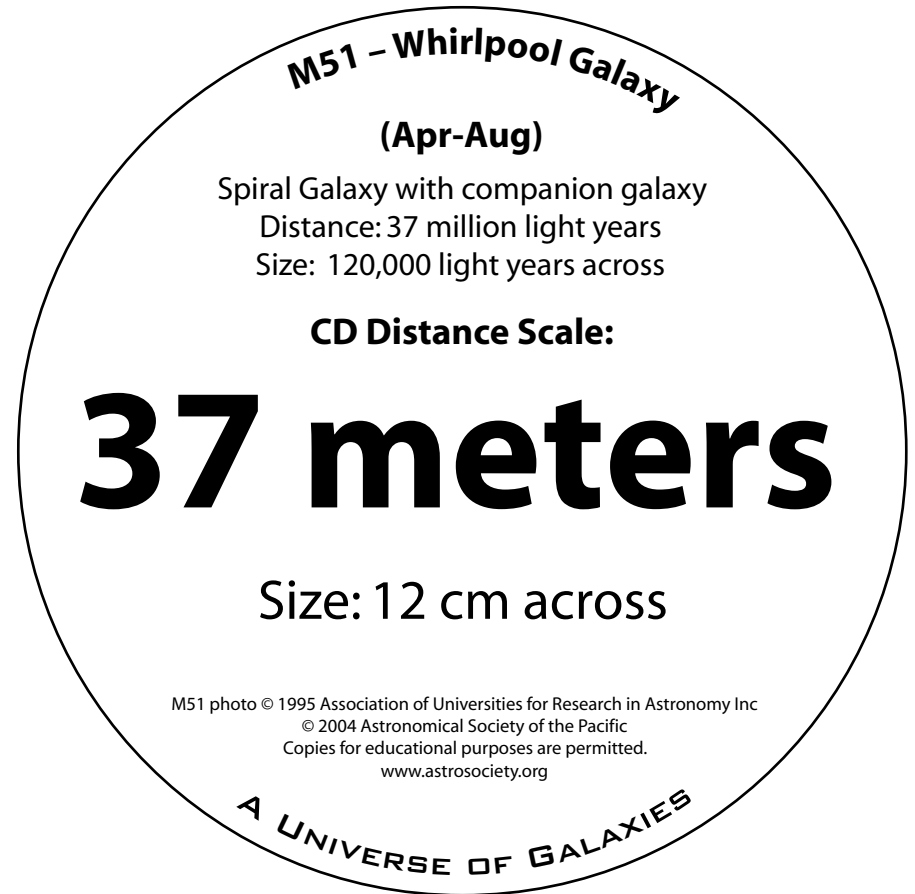
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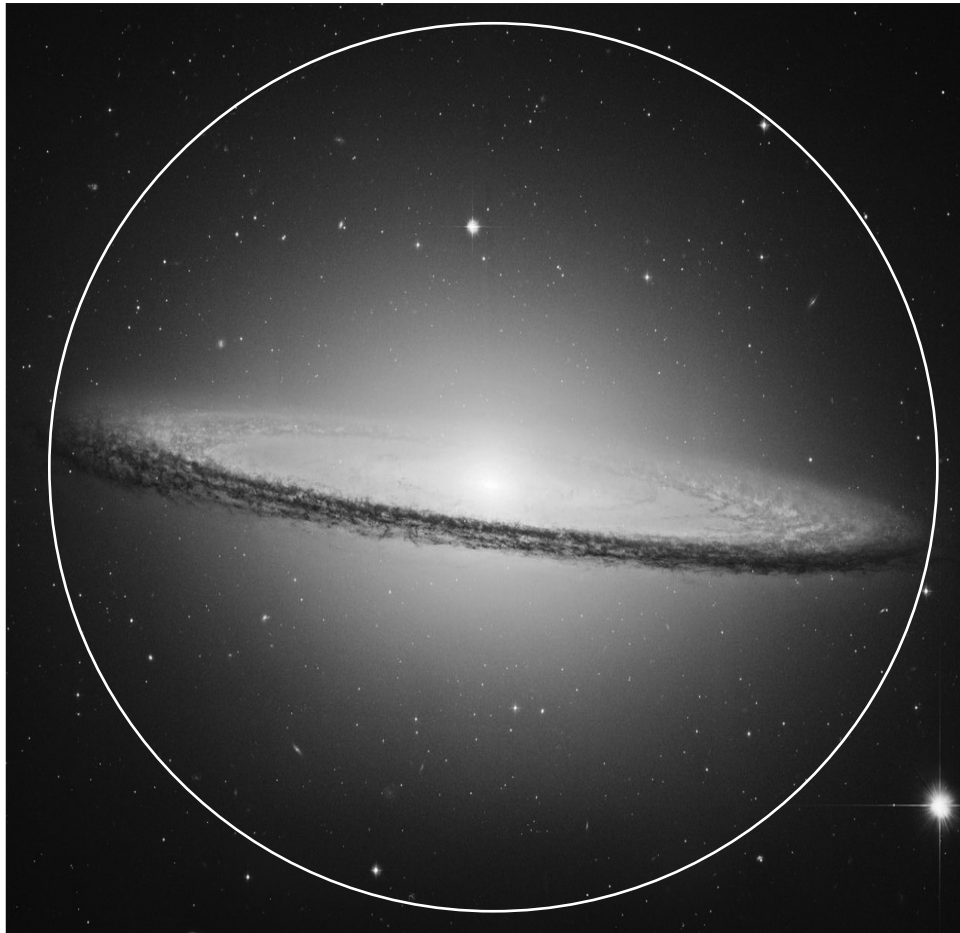
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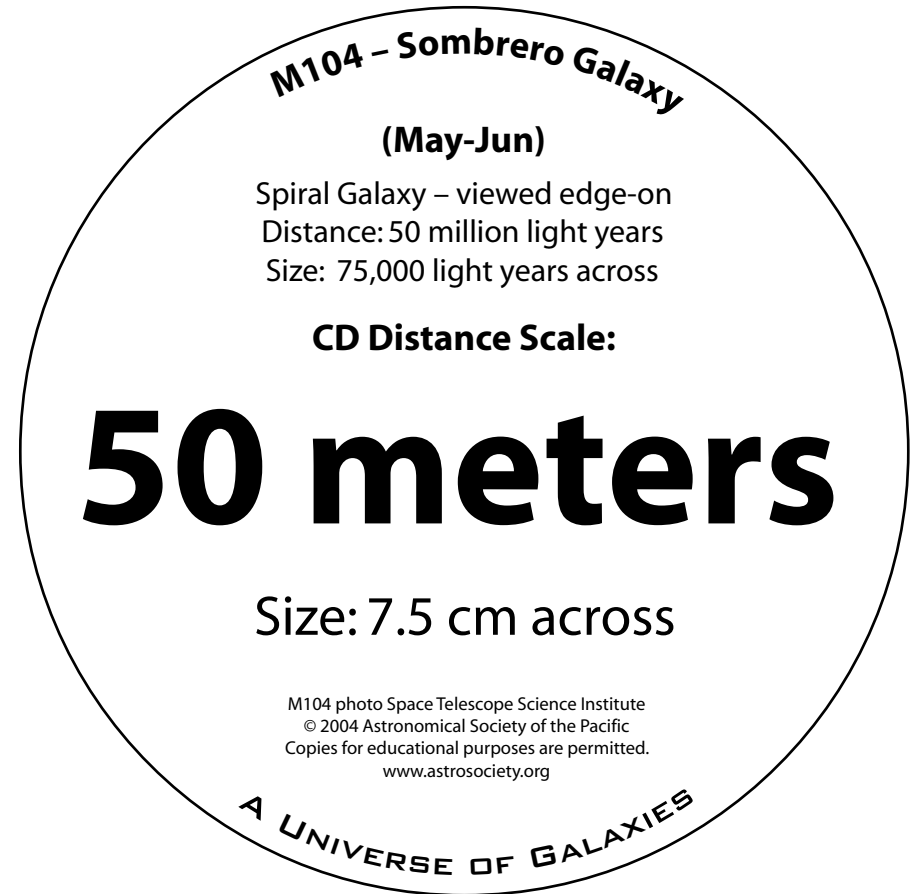
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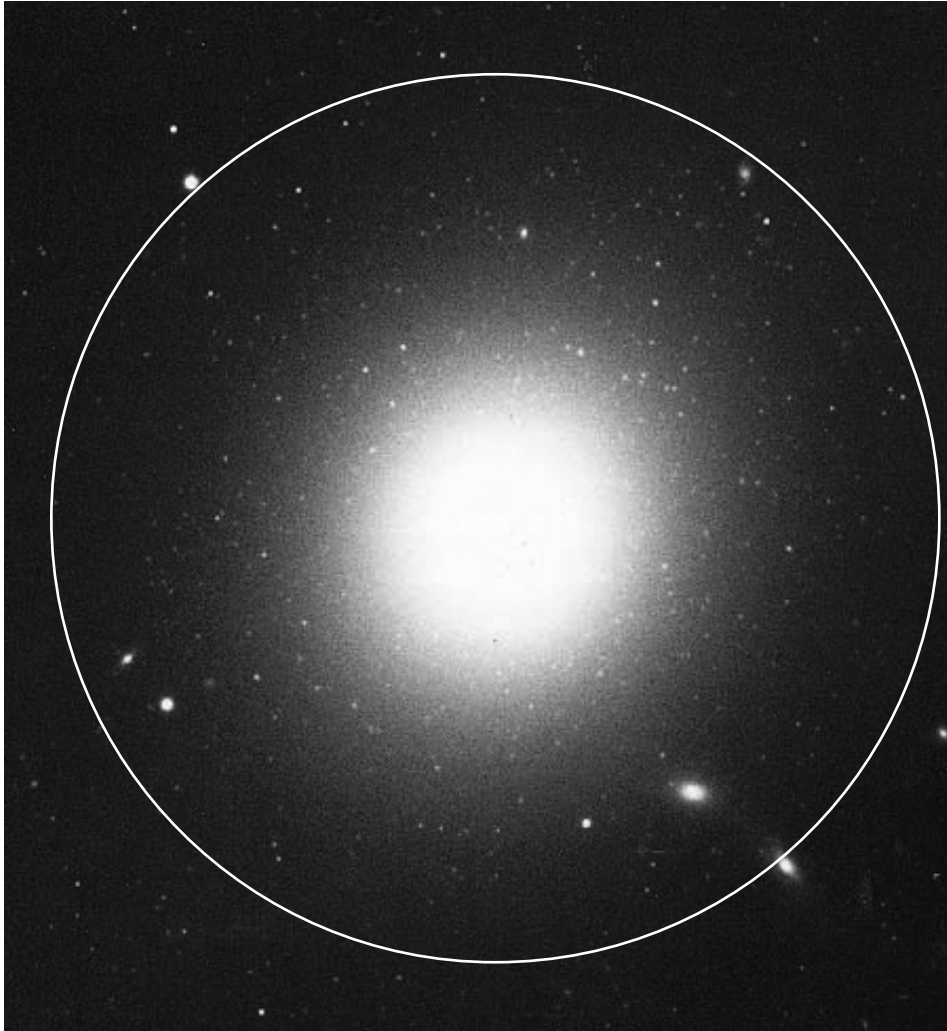
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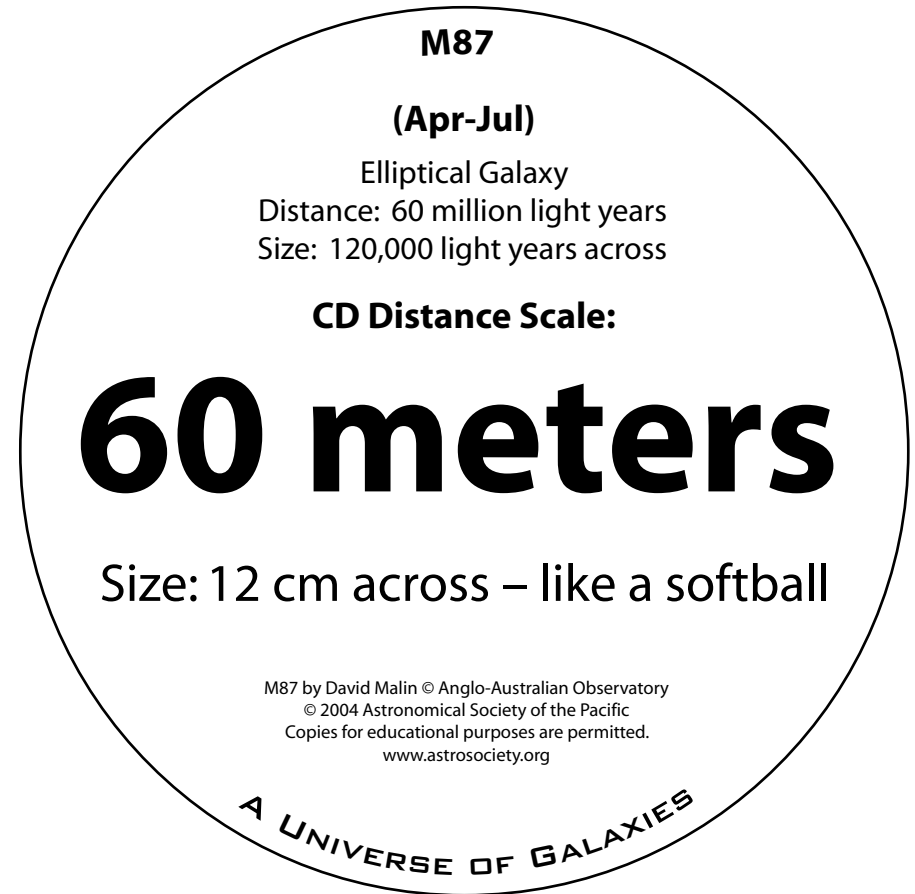
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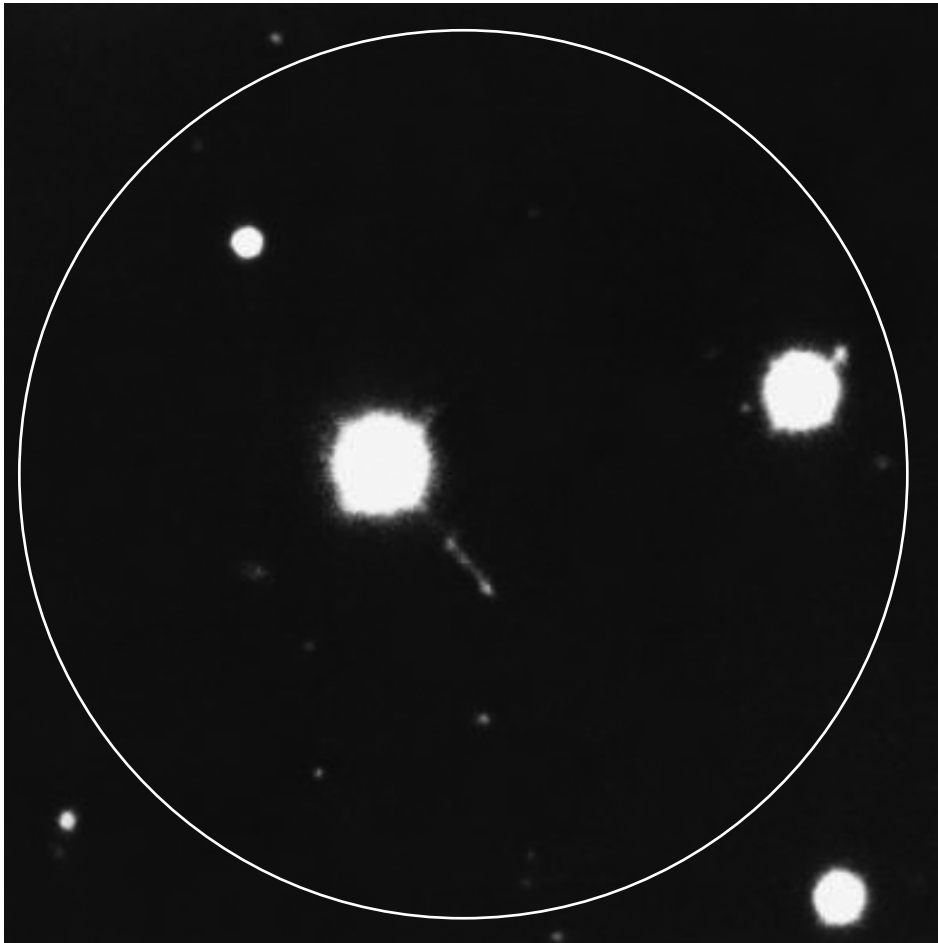
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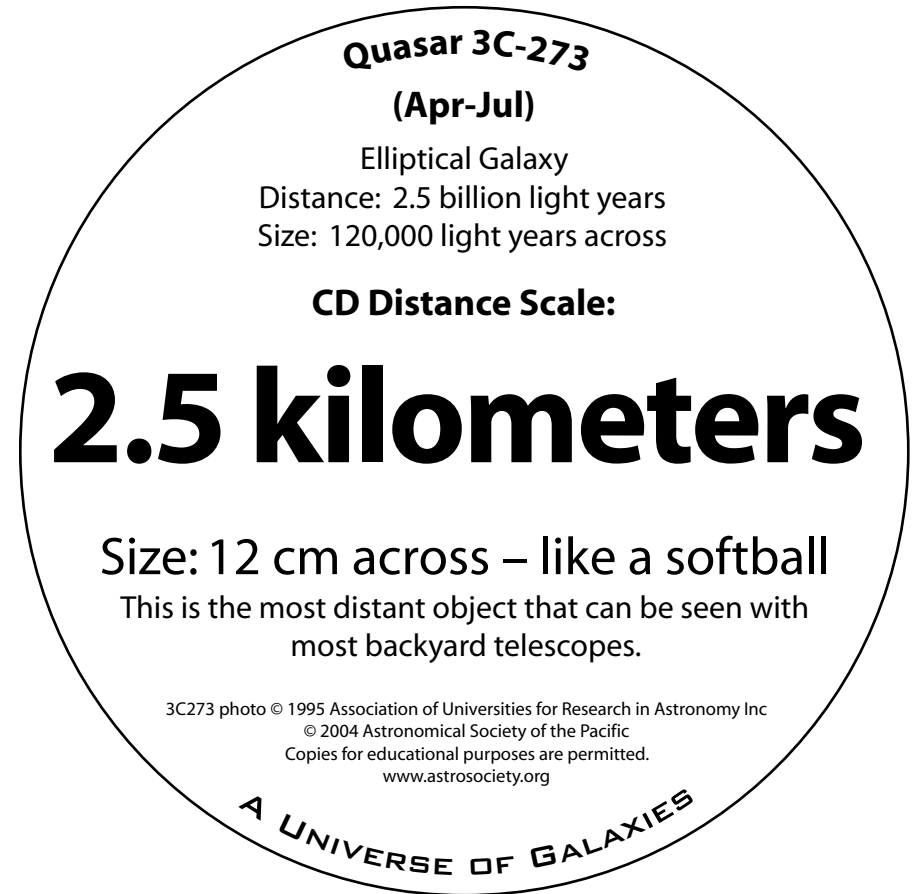
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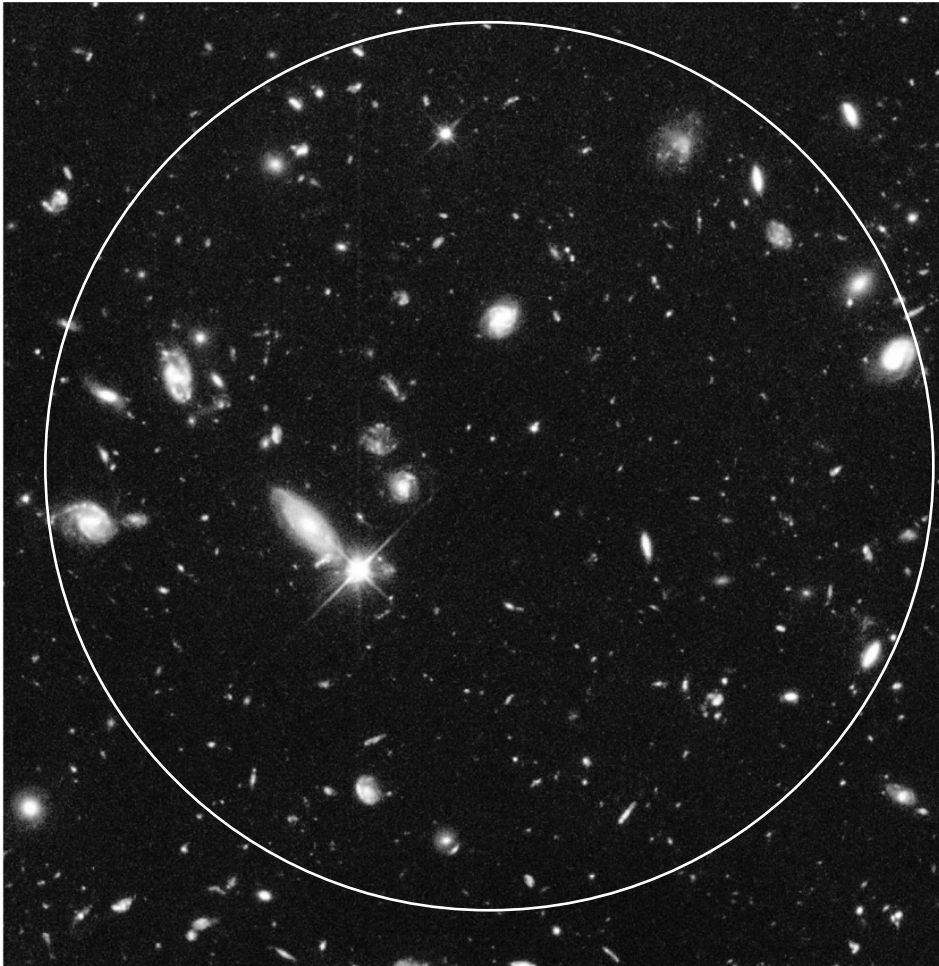
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FRONT

Hubble Deep Field

The **Hubble Deep Field** shows some of the most distant galaxies. This image is used to represent the limit of our observable universe: a distance of 13.7 billion light years.

CD Distance Scale:

13.7 kilometers

Location of Hubble Deep Field

R.A. 12h 36m
Dec 62° 12'

Hubble Deep Field photo Space Telescope Science Institute
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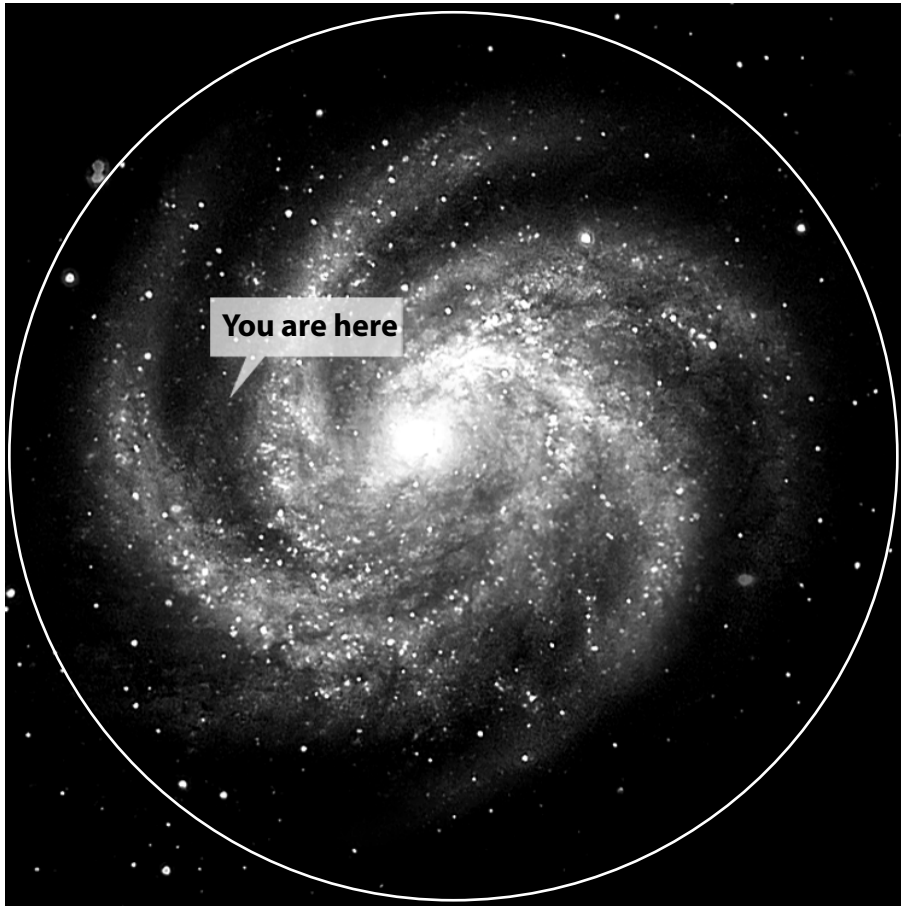
A UNIVERSE OF GALAXIES

BACK

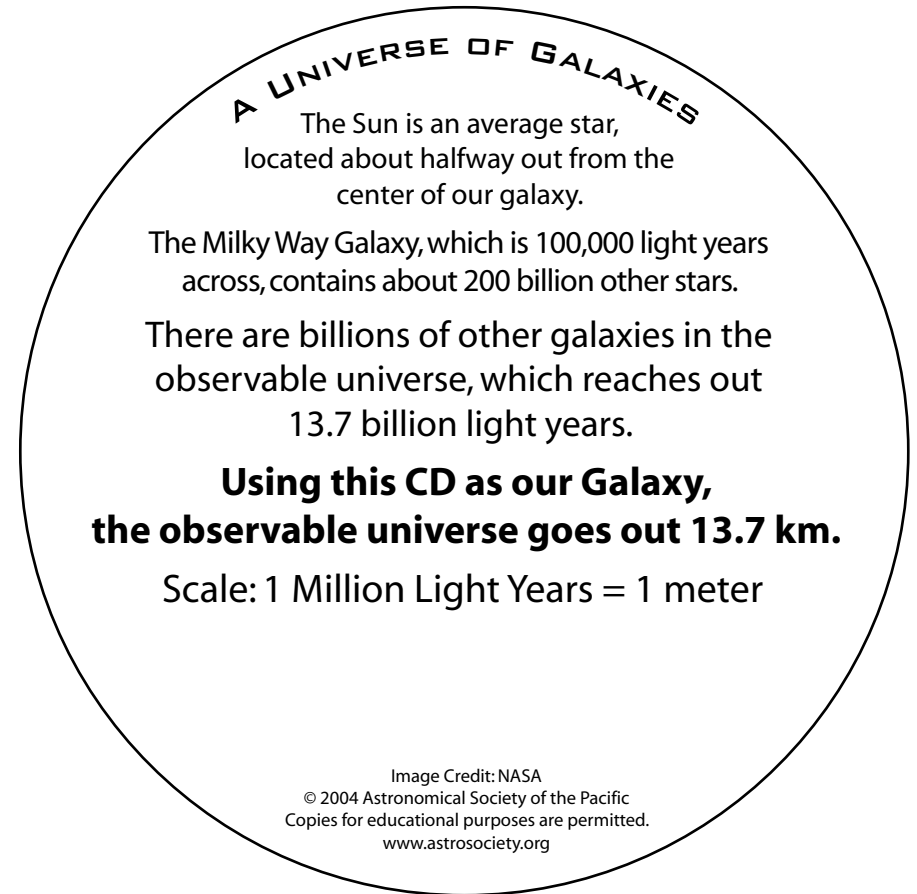
Instructions:

Cut out each circle and glue the "FRONT" to the label side of a used CD. Glue the "BACK" to the other side of the CD.

Make your own!



FRONT



BACK

Instructions:

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