The Cosmos in Perspective

This activity is adapted for Skynet Junior Scholars from "A Universe of Galaxies", which was created by the Astronomical Society of the Pacific for the Night Sky Network**.**

What's the Activity About?

What if we could shrink our galaxy to the size of a CD? How far away would the other galaxies be? With this activity we will be exploring a scale model to illustrate the large scale structure of the Universe.

Topics Covered

- What is our Cosmic Address?
- How far away are the other galaxies?
- How far to the limit of the observable universe?

Materials Needed

- Cosmic Address Pictures
- 15+ used CDs
- Scissors
- Glue stick

Setting up the Activity

You will need a large area, e.g. parking lot, playground, or park. The presentation takes about 15 minutes. Before the activity, reproduce the Cosmic Address pictures on card stock and cut them out. Assemble the galaxy CDs. Cut out the CD labels and attach them to the CDs. Each page contains two sides of the same disk.

Part One: My Cosmic Address
Understanding the sizes and distances of celestial objects can be tricky because in our everyday experience, the stars all seem the same distance away.. Most people's knowledge of dim and distant objects such as nebulae and galaxies comes mainly from images in books, where all the images are about the same size with no indication of scale.

Pass out the cosmic address pictures and ask participants to sort them based on size. Use the pictures to come up with a cosmic address (Have a discussion and let each youth offer a piece of the address: Street, City, County, State, Country, Continent, Earth, Solar System, Milky Way Galaxy, Local Group, Universe)

Part Two: Large Scale Structure of our Universe
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.

Ask: "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?" (Accept any responses)

Pass out galaxies or have someone pass them out (don't pass out the Quasar or the Hubble Deep Field yet). With the Milky Way Galaxy person in the middle, have participants pace off the distance to each of their galaxies. Giant steps = 1 meter.

Say: “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.
These are just a few of the billions of galaxies in our universe. These are all fairly close to us. These are galaxies we can observe with the Skynet telescopes. 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?”

(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.)

Wrap-up

“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. So, to review: On the scale we’ve built, how big is our Galaxy, the Milky Way? (Hold up the Milky Way CD)”

Note: 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”.

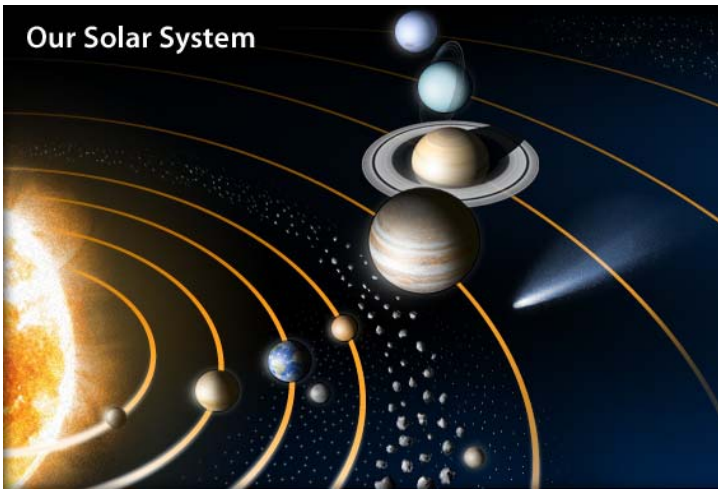
Extension:

After doing the Galaxy activity, you can extend the learning by using the CDs to represent other cosmic objects: This web site will help you make new scale models. A CD is 120 mm in diameter):
http://exploratorium.com/ronh/solar_system/

1. What if the Sun were the size of a CD (120 mm), how would the planets scale in size and distance? (Jupiter would be smaller than a dime and would be 67 meters away!! Earth would be just 1 millimeter in diameter and would be 13 meters away.)
2. If our Sun were the same size as a CD, how do distances between the stars compare to distances between the galaxies? (The nearest star would be 2000 miles away!!)

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.

Cosmic Address Photos. Cut out for youth to sort.


Our Solar System

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

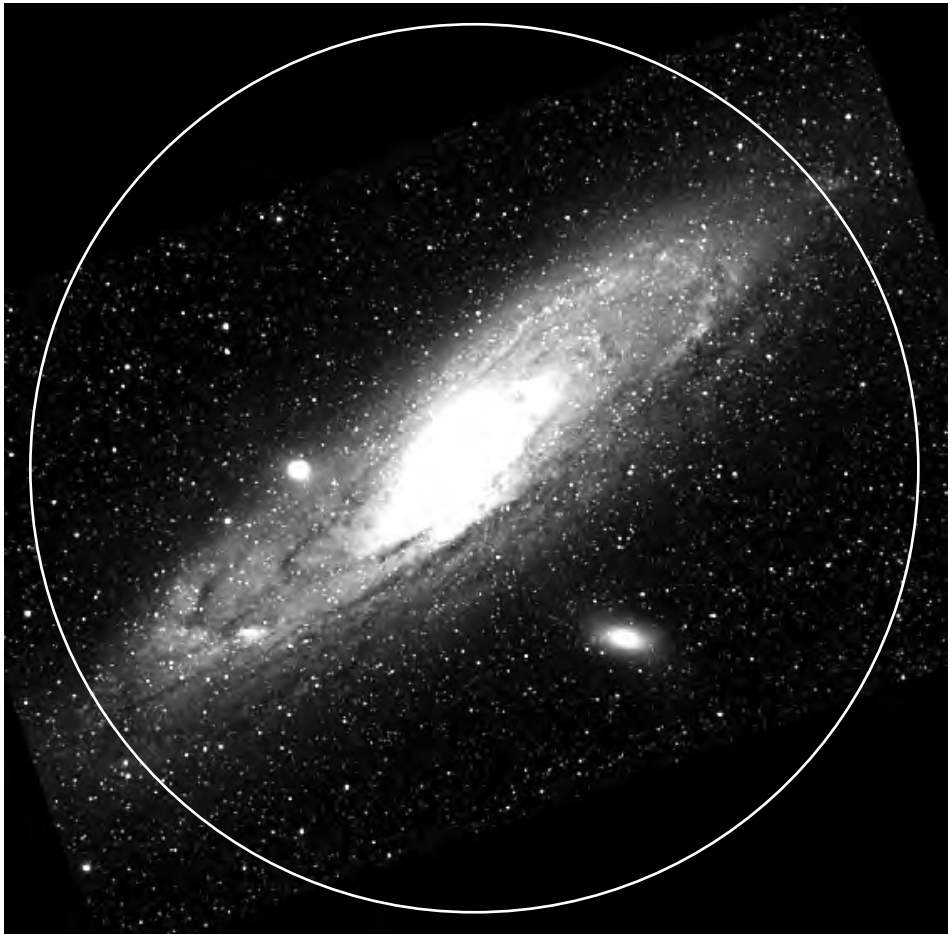
Image Credit: NASA

www.astrosociety.org

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.



FRONT

M31 – The Andromeda Galaxy

(Oct-Jan)

Spiral Galaxy
Distance: 2.3 million light years
Size: 150,000 light years across

CD Distance Scale:

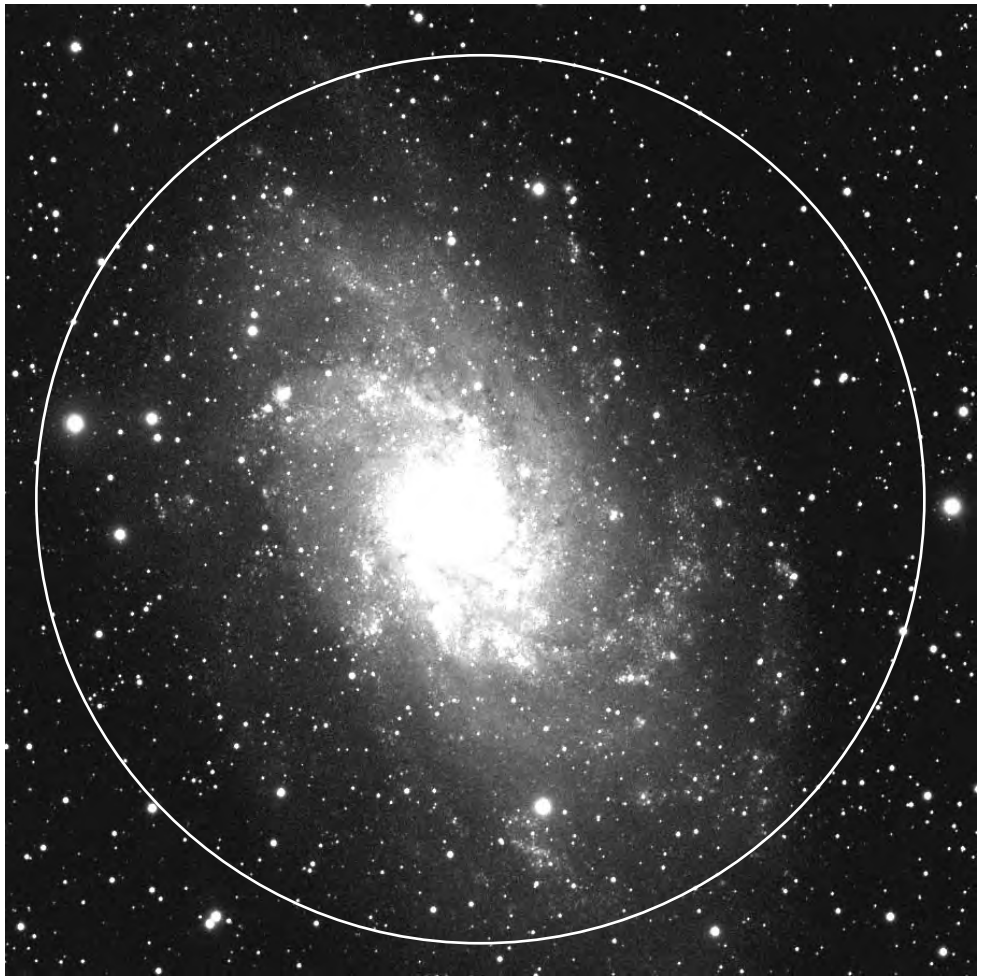
2.3 meters

Size: 15 cm across (salad plate)

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.



FRONT

M33 – The Pinwheel Galaxy

(Oct-Jan)

Spiral Galaxy
Distance: 2.4 million light years
Size: 60,000 light years across

CD Distance Scale:

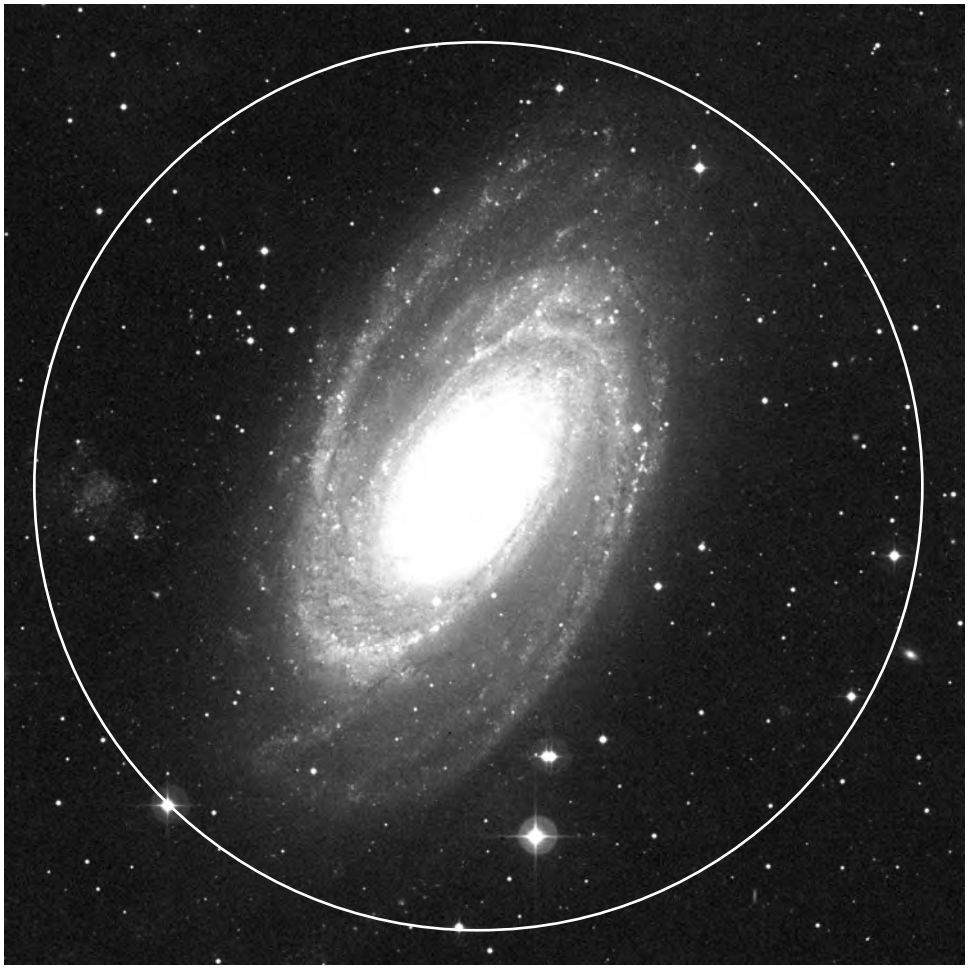
2.4 meters

Size: 6 cm across

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.



FRONT

M81

(Feb-Jun)

Spiral Galaxy
Distance: 12 million light years
Size: 75,000 light years across

CD Distance Scale:

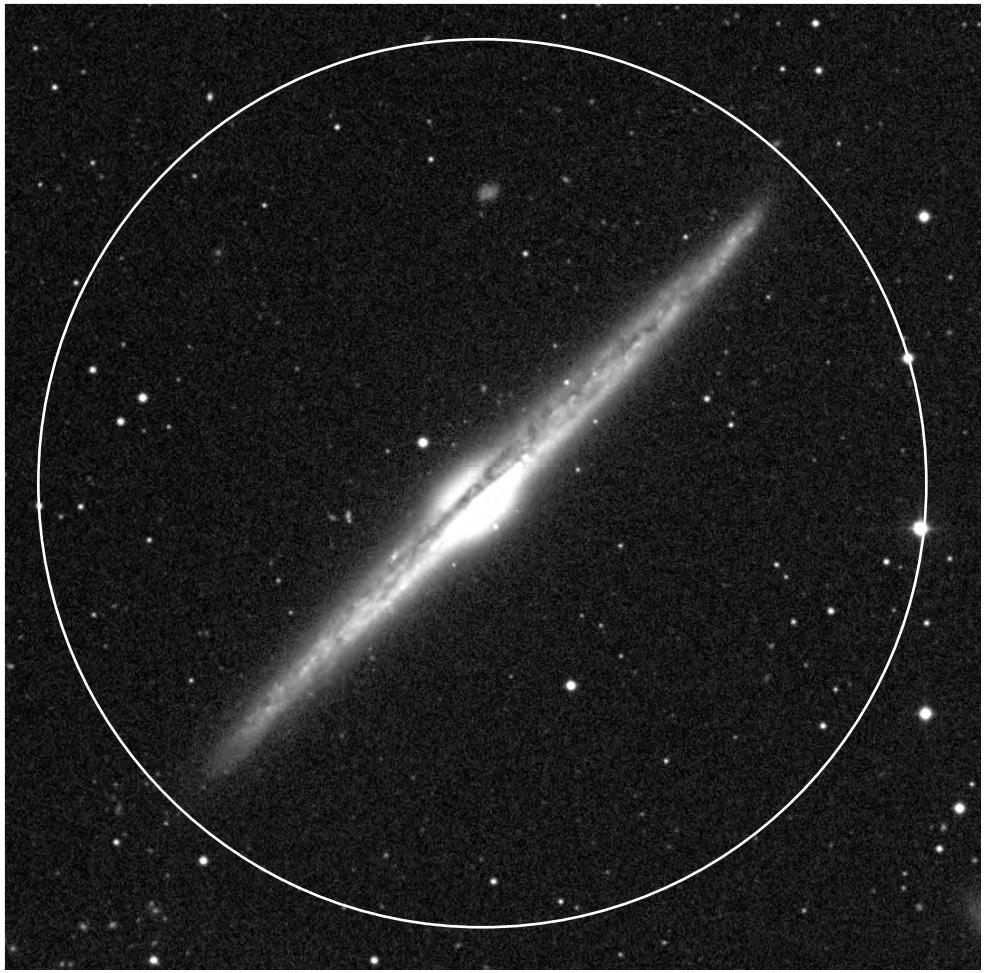
12 meters

Size: 7.5 cm across

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.



FRONT

NGC4565

(Apr-Jul)

Spiral Galaxy – viewed edge-on
Distance: 31 million light years
Size: 150,000 light years across

CD Distance Scale:

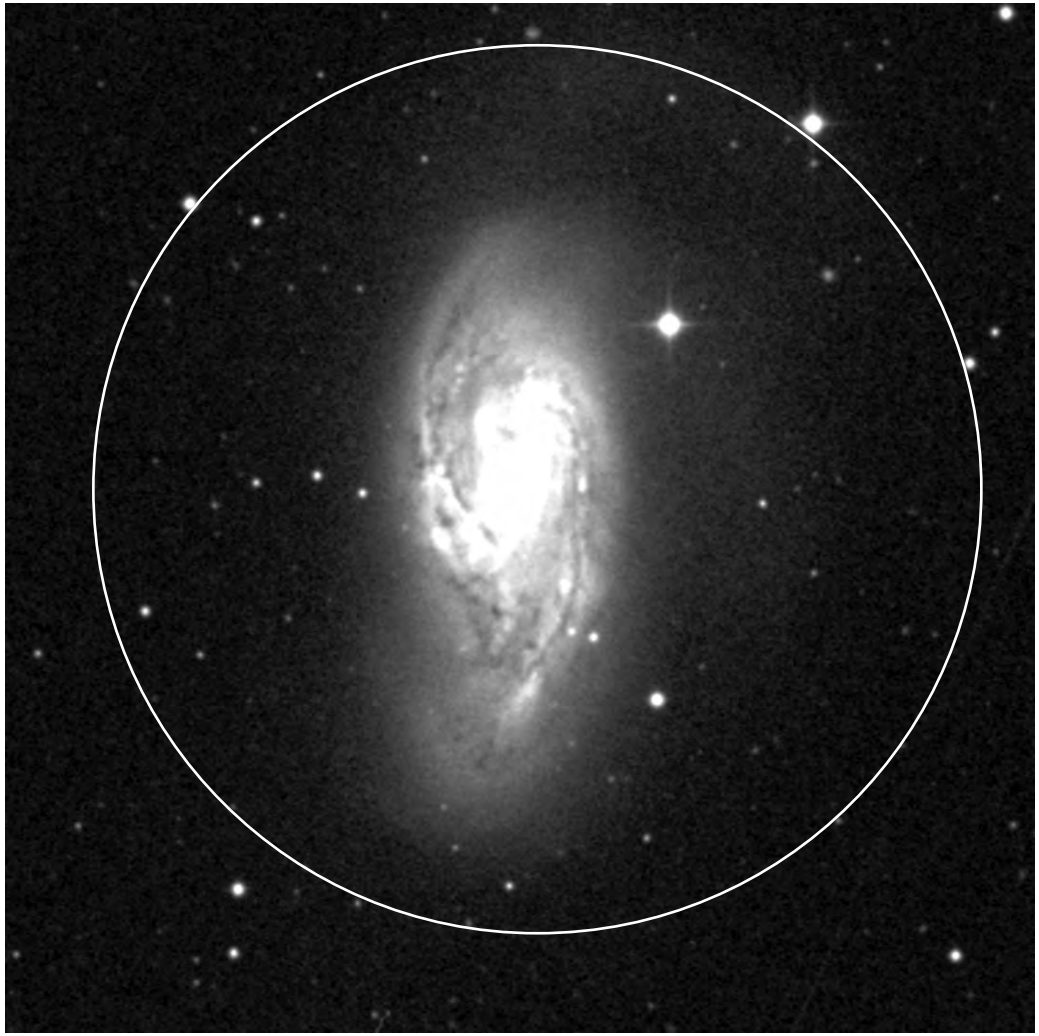
31 meters

Size: 15 cm across (salad plate)

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.



FRONT

M66

(Apr-Jun)

Spiral Galaxy
Distance: 35 million light years
Size: 80,000 light years across

CD Distance Scale:

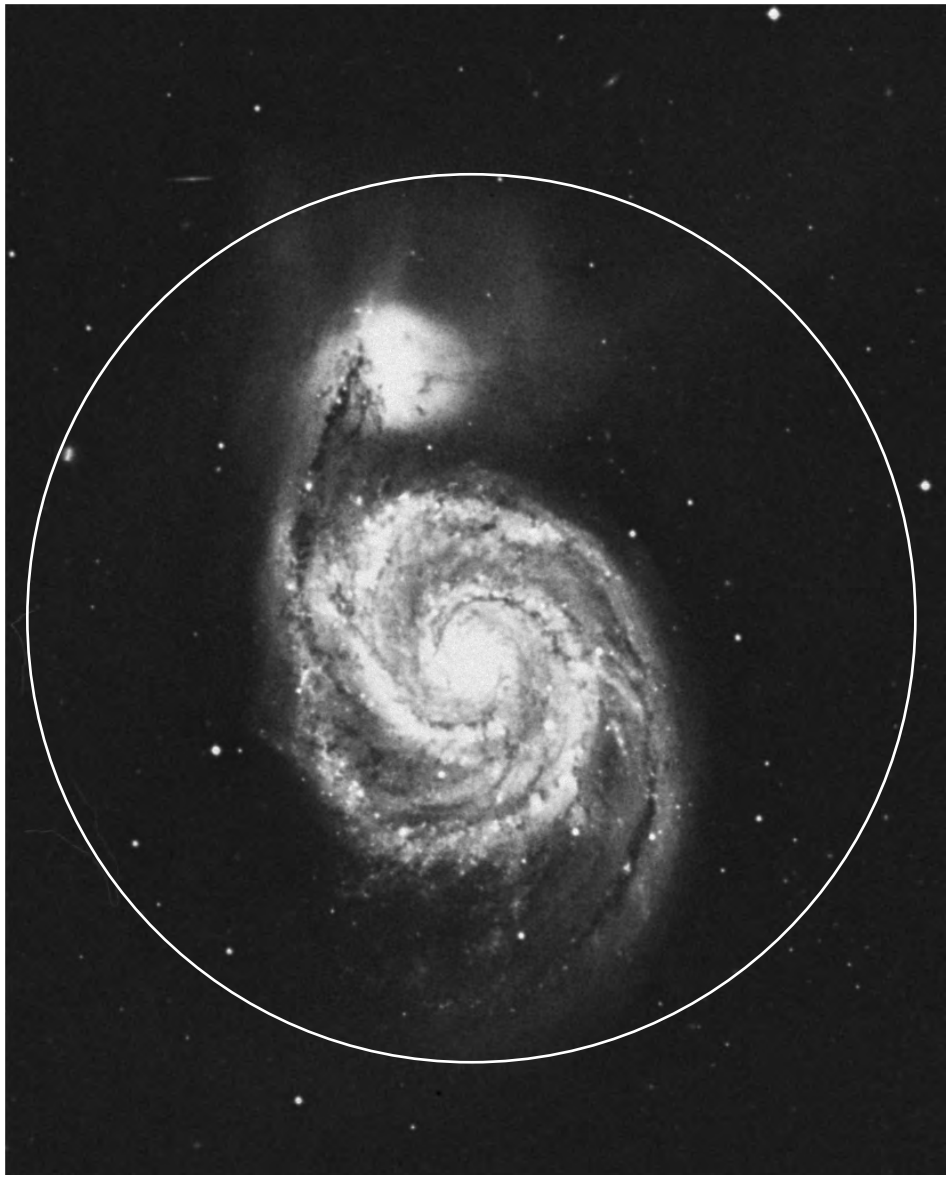
35 meters

Size: 8 cm across

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.



FRONT

M51 – Whirlpool Galaxy

(Apr-Aug)

Spiral Galaxy with companion galaxy
Distance: 37 million light years
Size: 120,000 light years across

CD Distance Scale:

37 meters

Size: 12 cm across

A Universe of Galaxies

BACK

Instructions:
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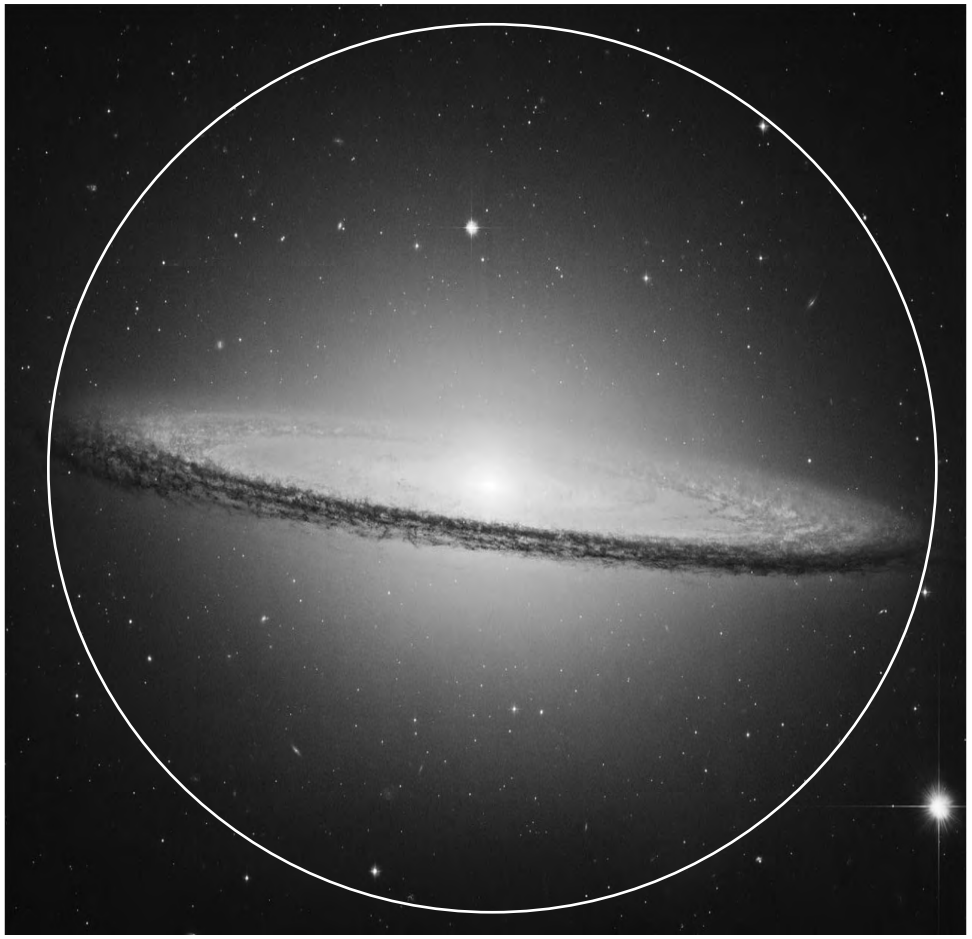


FRONT

M104 – Sombrero Galaxy

(May-Jun)

Spiral Galaxy – viewed edge-on
Distance: 50 million light years
Size: 75,000 light years across

CD Distance Scale:

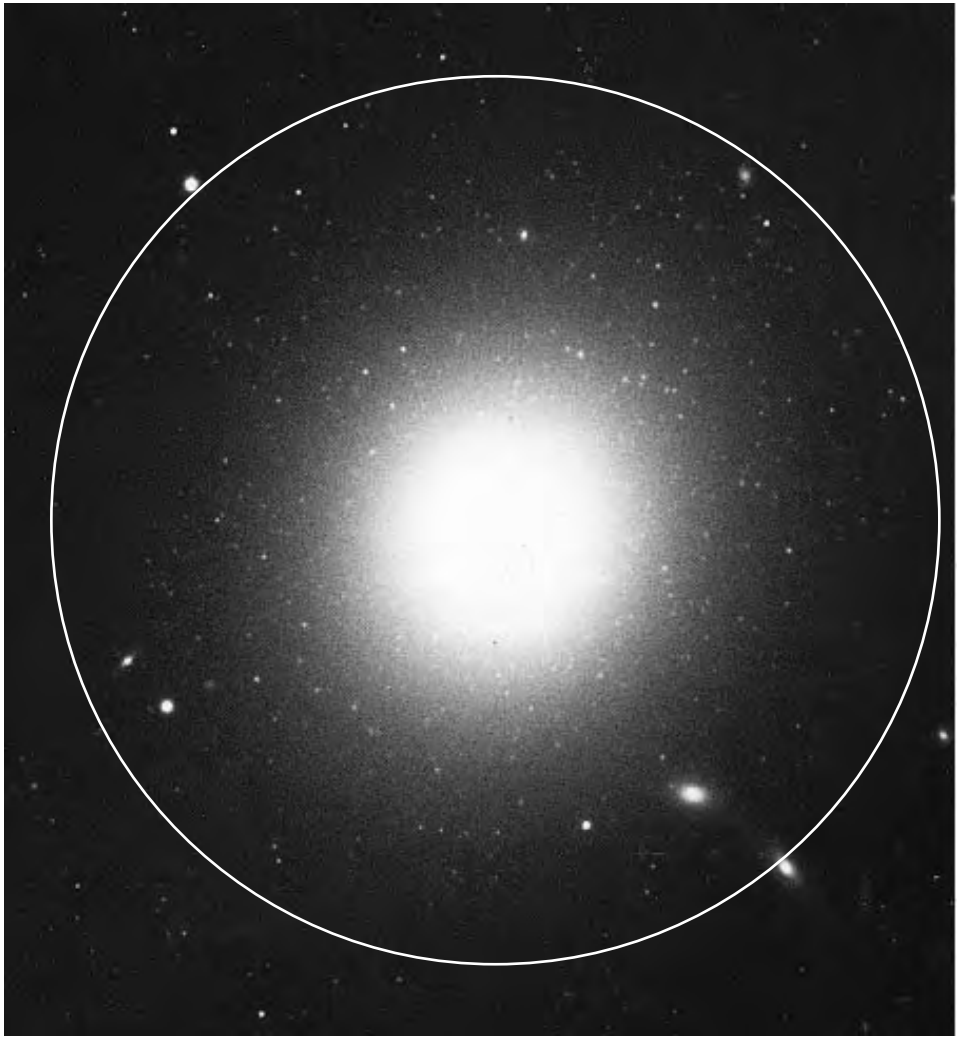
50 meters

Size: 7.5 cm across

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.



FRONT

M87

(Apr-Jul)

Elliptical Galaxy
Distance: 60 million light years
Size: 120,000 light years across

CD Distance Scale:

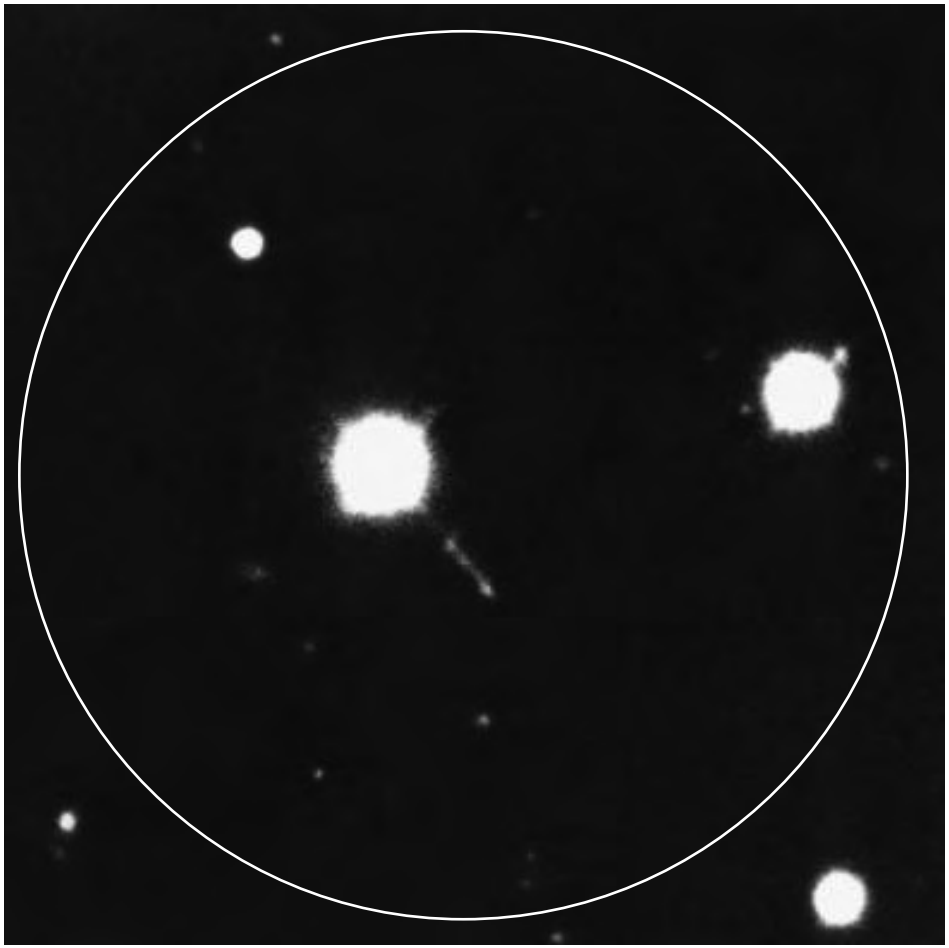
60 meters

Size: 12 cm across – like a softball

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.



FRONT

Quasar 3C-273

(Apr-Jul)

Elliptical Galaxy
Distance: 2.5 billion light years
Size: 120,000 light years across

CD Distance Scale:

2.5 kilometers

Size: 12 cm across – like a softball
This is the most distant object that can be seen with most backyard telescopes.

A UNIVERSE OF GALAXIES

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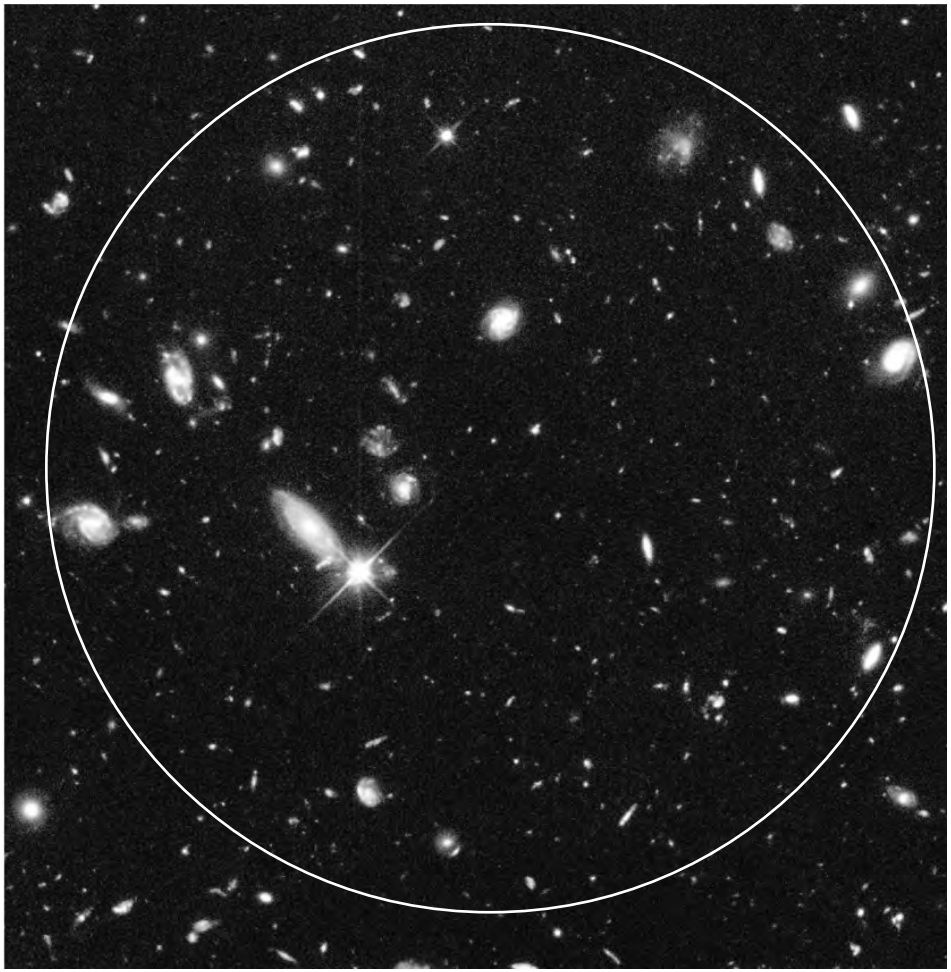


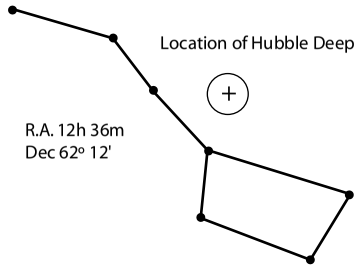
FRONT

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



A Universe of Galaxies

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