



COLOR
— THE —
UNIVERSE

Brought to you by
NASA'S CHANDRA X-RAY OBSERVATORY
and Universe Awareness



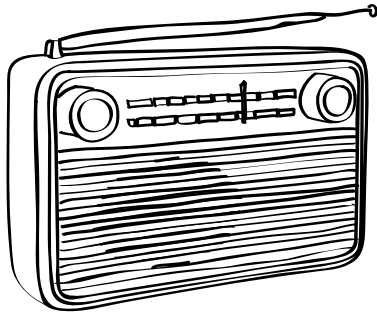
LIGHT

Looking up at the night sky, you might think that space is dull, with lots of black, some white dots and just a hint of red if you're lucky. But if we look deeper, space has a lot more to offer than what our eyes can see!

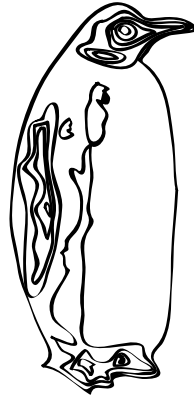
You may have heard the phrase 'visible light'. This is what we call the range of colors that humans can see with their eyes. Visible light is just a tiny portion of all light. So astronomers have built special telescopes to see things that human eyes can't.

There are many kinds of light that can be detected by special telescopes, such as infrared, ultraviolet and X-ray.

X-RAYS



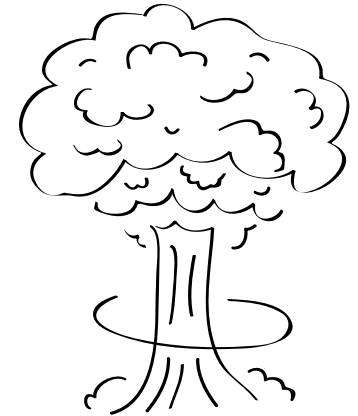
Radio Waves



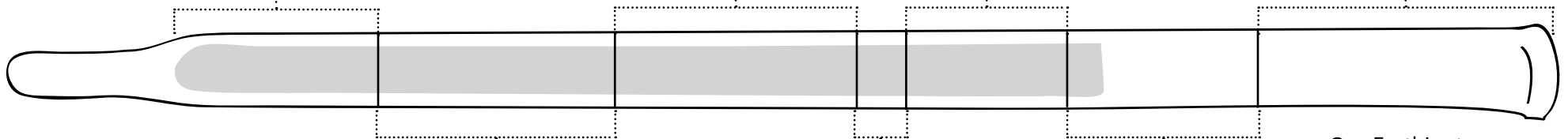
Infrared Rays



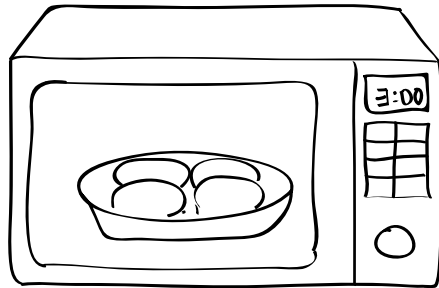
Ultraviolet Rays



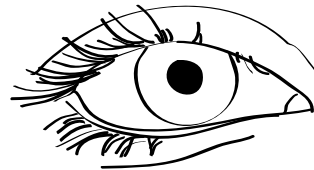
Gamma Rays



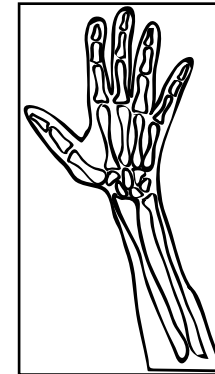
Microwave



Visible



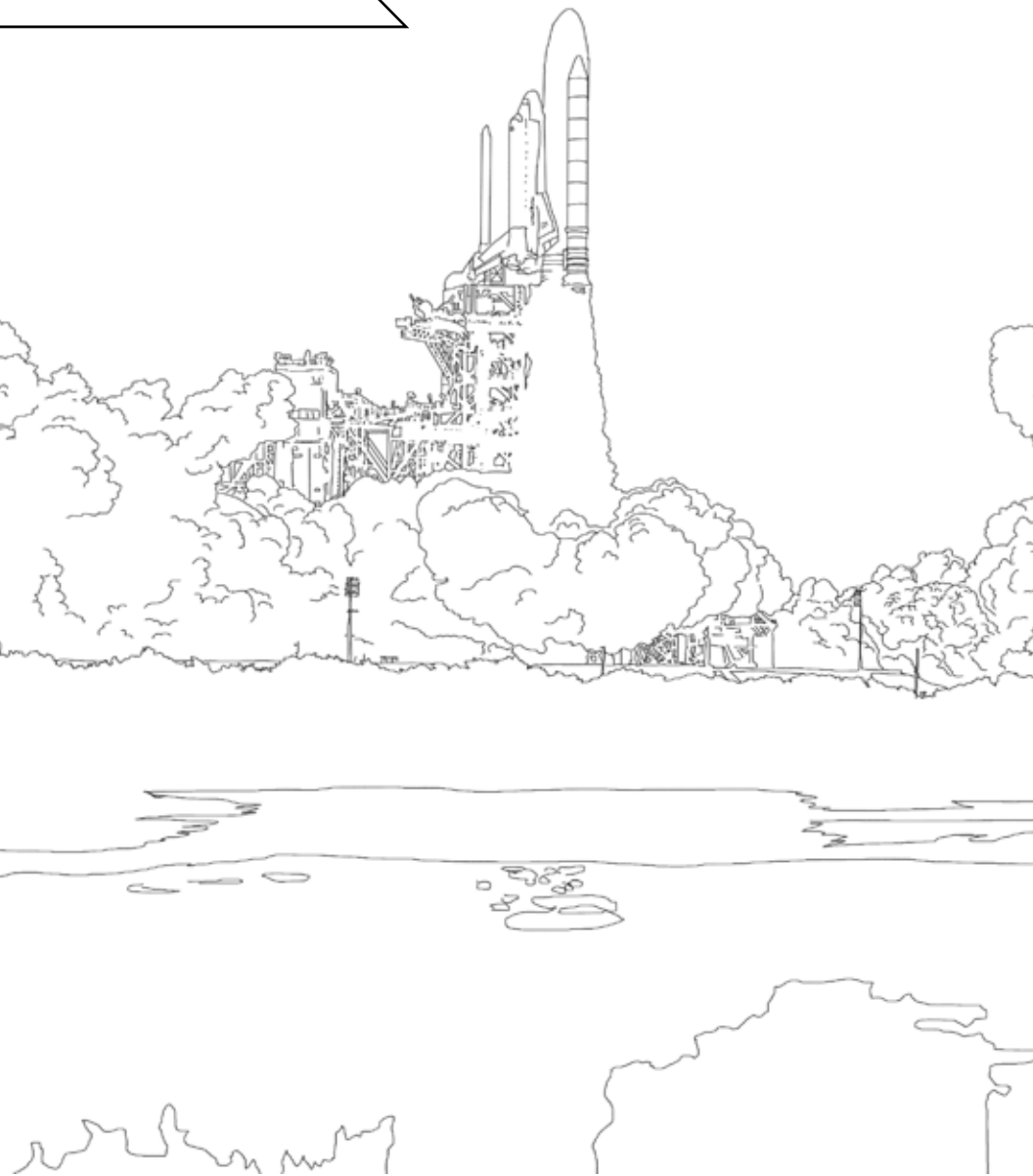
X-Rays



Our Earth's atmosphere blocks harmful radiation from space, such as X-rays, from reaching the ground—we couldn't survive without it! But astronomers like to study this radiation because it gives us useful information about objects in the Universe, such as stars and galaxies.

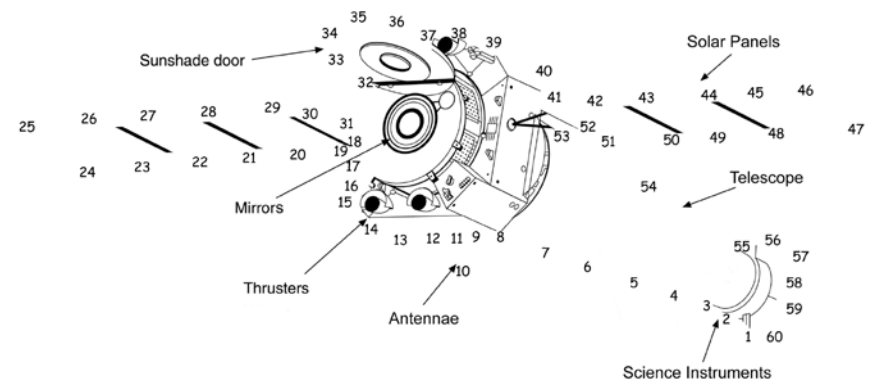
So what can they do?

LAUNCH



NASA's Chandra X-ray Observatory was launched on Space Shuttle Columbia in July of 1999.

CHANDRA

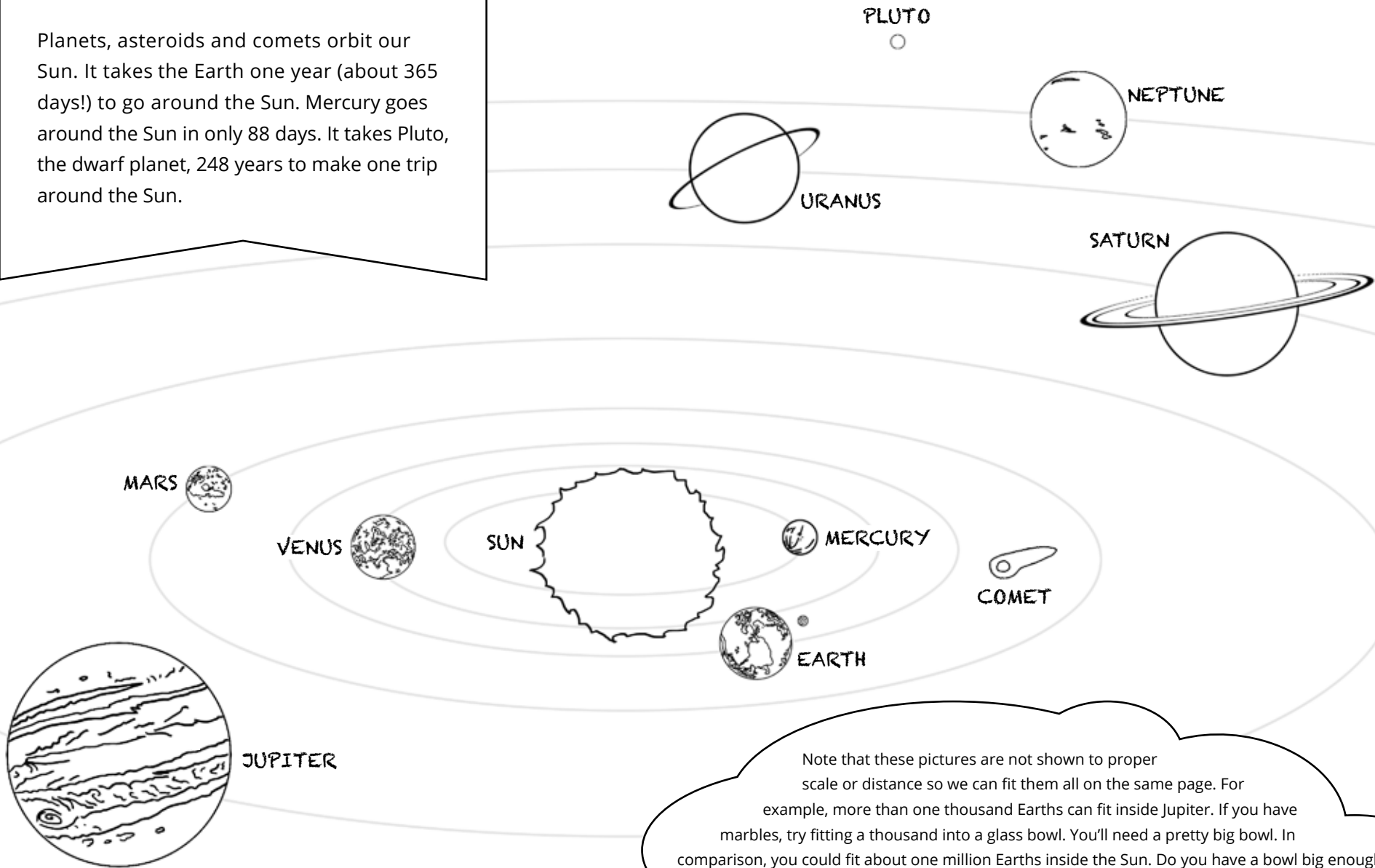


Scientists launch some telescopes into space—to go beyond Earth's protective atmospheric shield. One of these telescopes, called the Chandra X-ray Observatory, detects X-ray radiation that has travelled across the Universe. The information that the telescope collects is then beamed down to astronomers on Earth to study and to create fantastic pictures.

One star, eight planets, and a collection of moons, comets, asteroids and dwarf planets. This is our planet's local neighborhood known as the Solar System.

Planets, asteroids and comets orbit our Sun. It takes the Earth one year (about 365 days!) to go around the Sun. Mercury goes around the Sun in only 88 days. It takes Pluto, the dwarf planet, 248 years to make one trip around the Sun.

SOLAR SYSTEM

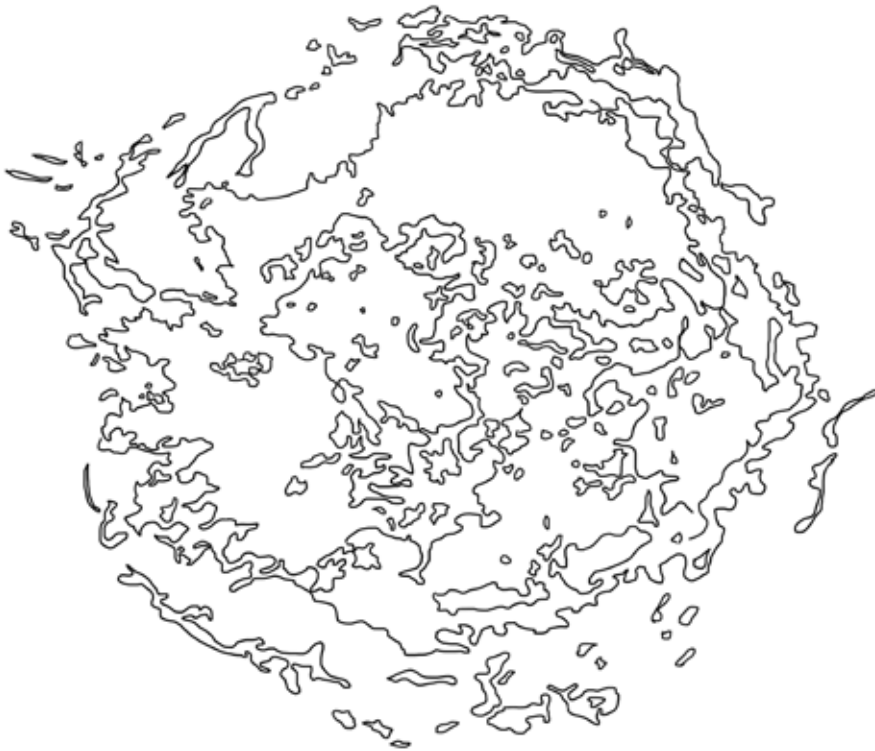


Note that these pictures are not shown to proper scale or distance so we can fit them all on the same page. For example, more than one thousand Earths can fit inside Jupiter. If you have marbles, try fitting a thousand into a glass bowl. You'll need a pretty big bowl. In comparison, you could fit about one million Earths inside the Sun. Do you have a bowl big enough for one million marbles?

STARS

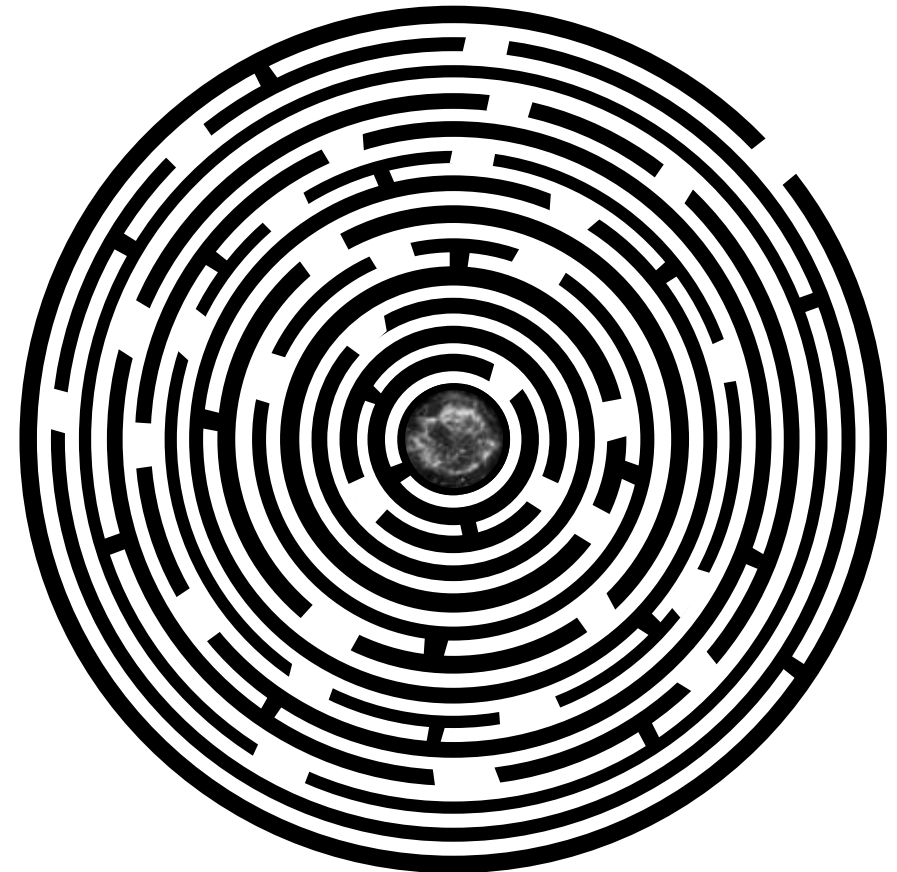


Our Sun is a star. It is the closest star we'll ever see. It is about 4.5 billion years old, and will live for about five billion more years. But not all stars live this long. Really big stars, those ten to twenty times bigger than the Sun, live only a few million years. And when they burn out, they go out with a bang!



Supernova Remnant, Cassiopeia A

Every 50 years or so, a massive star in our Galaxy explodes in what is called a supernova. In the explosion, the star's outer shells of gas are blown into space. This hot gas gives off X-ray radiation, which astronomers can make images of using special telescopes in space. What remains of the star is squashed into a tiny ball, which

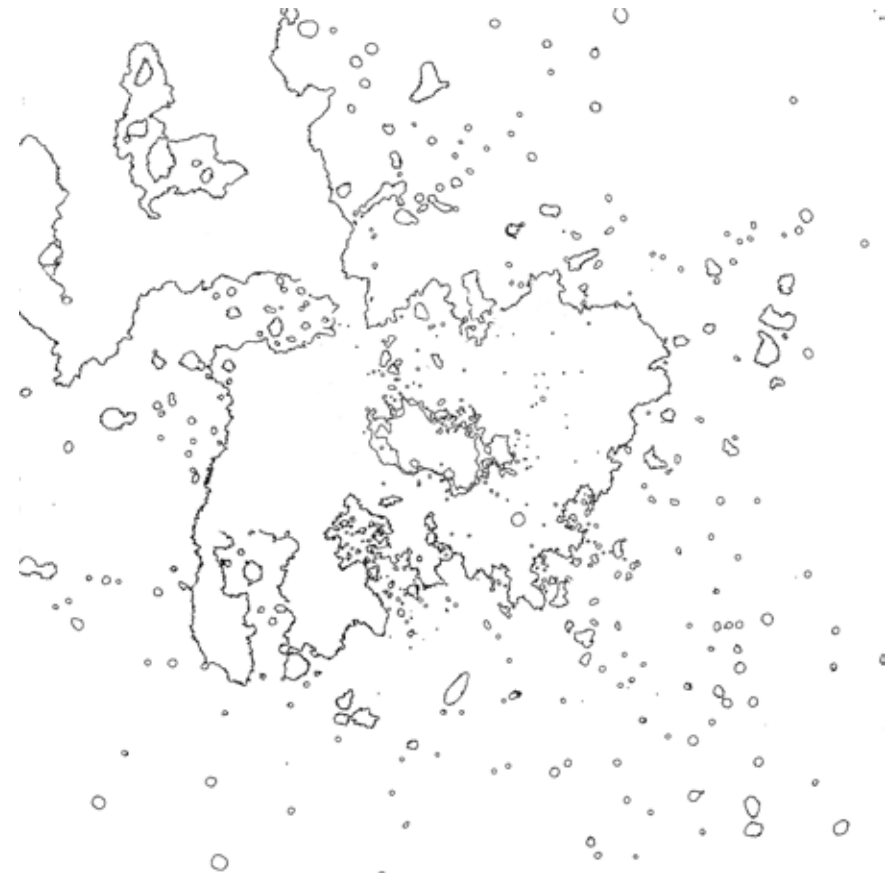
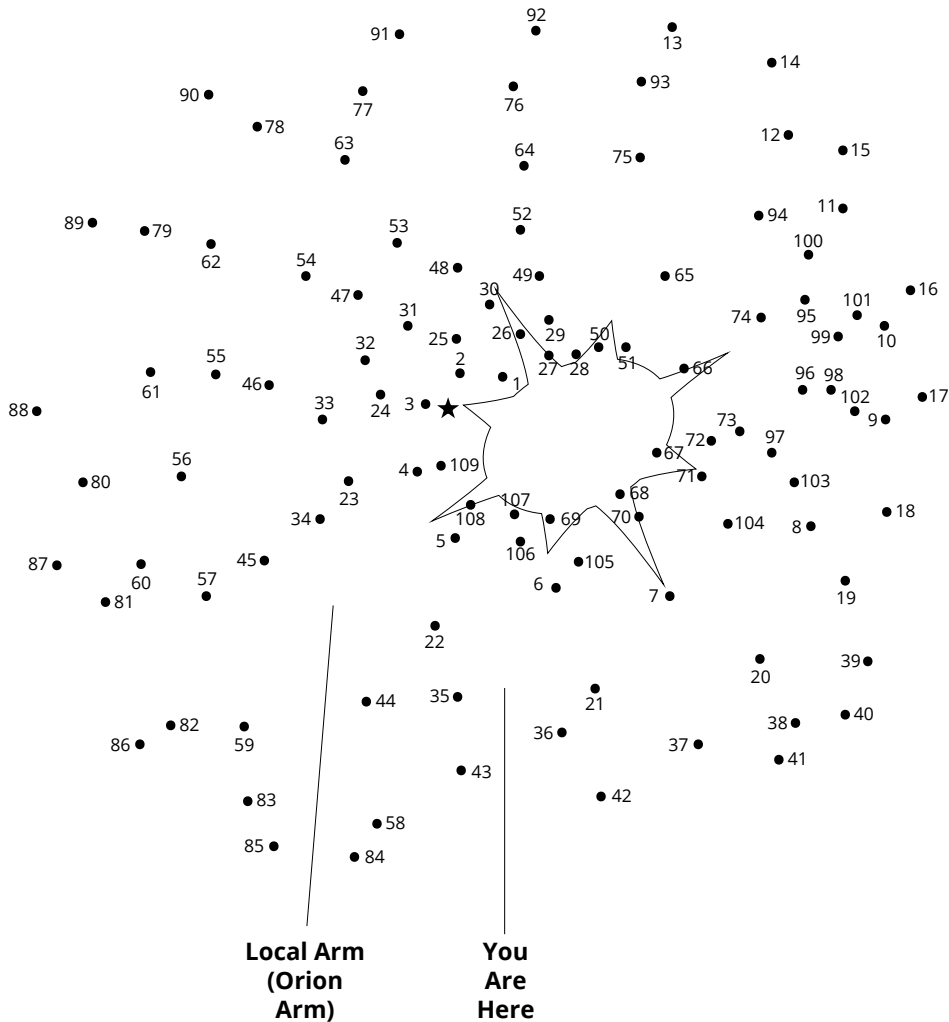


Find the Supernova Remnant

is then called a neutron star. A neutron star has a mass about twice that of our Sun, but packed into a ball that is only 24 km (15 mi) wide—that's about 60,000 times narrower than our Sun!

The scattered, glowing remains from the explosion are called a supernova remnant.

MILKY WAY



Sagittarius A*

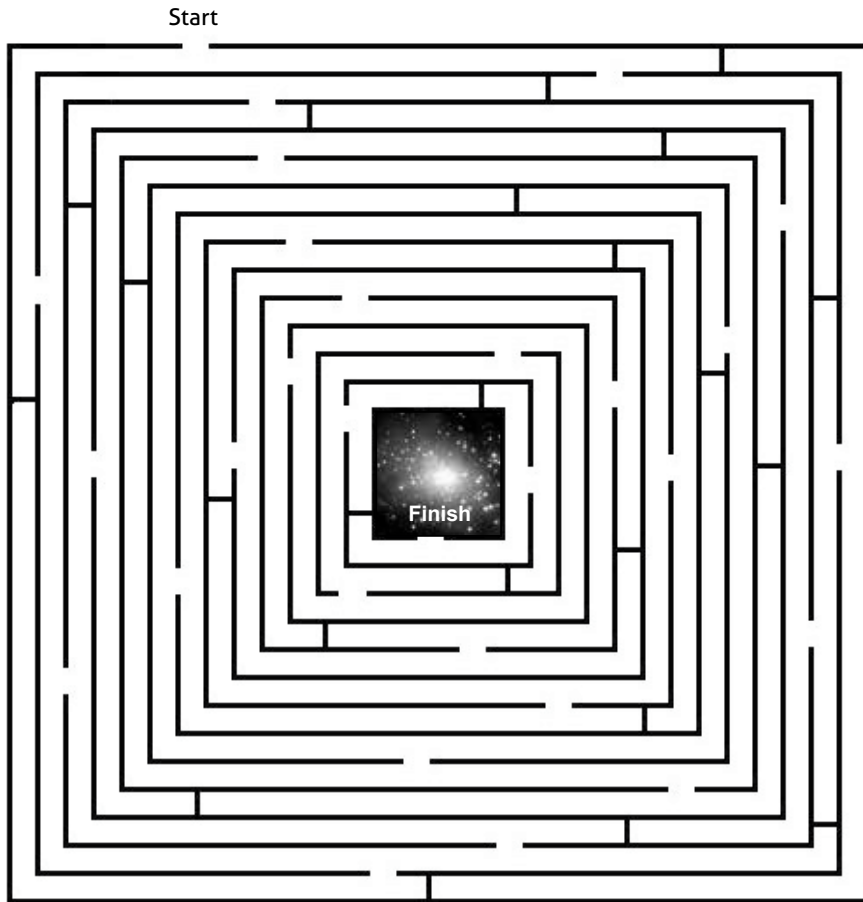
The Milky Way is our home galaxy—a huge rotating spiral of gas, dust, and hundreds of billions of stars. Our Sun and the planets in our solar system formed in one of the arms of the Milky Way about 4.5 billion years ago.

At the center of most galaxies there is a giant black hole. Anything that gets too close to a black hole is pulled to it with such a strong force that it has no chance of escape—not even light!

The giant black hole at the center of our Galaxy is called Sagittarius A*. Over several years, astronomers have noticed mysterious flares of X-ray light coming from Sagittarius A*. Now, astronomers think that these flares of light may be caused by Sagittarius A* gobbling up asteroids, just like the streak of light that we see in the night sky when meteorites (or 'shooting stars') burn up.

If this theory is correct, then there must be hundreds of trillions of asteroids and comets around Sagittarius A*!

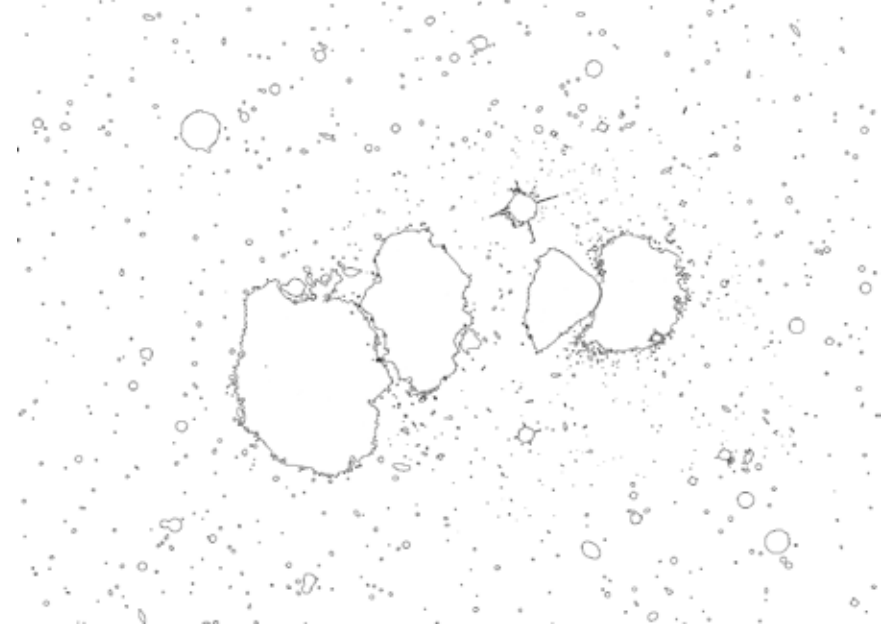
GALAXIES



Find the galaxy

It's hard to picture just how big the Universe is. For instance, the Earth seems like a big place to us, but you could fit about one million Earths inside our nearest star, the Sun. And the Sun is just one of billions of stars that make up our Milky Way galaxy. When you think about how the Milky Way is just one galaxy in a group of about forty nearby galaxies, the Universe is starting to seem like a big place!

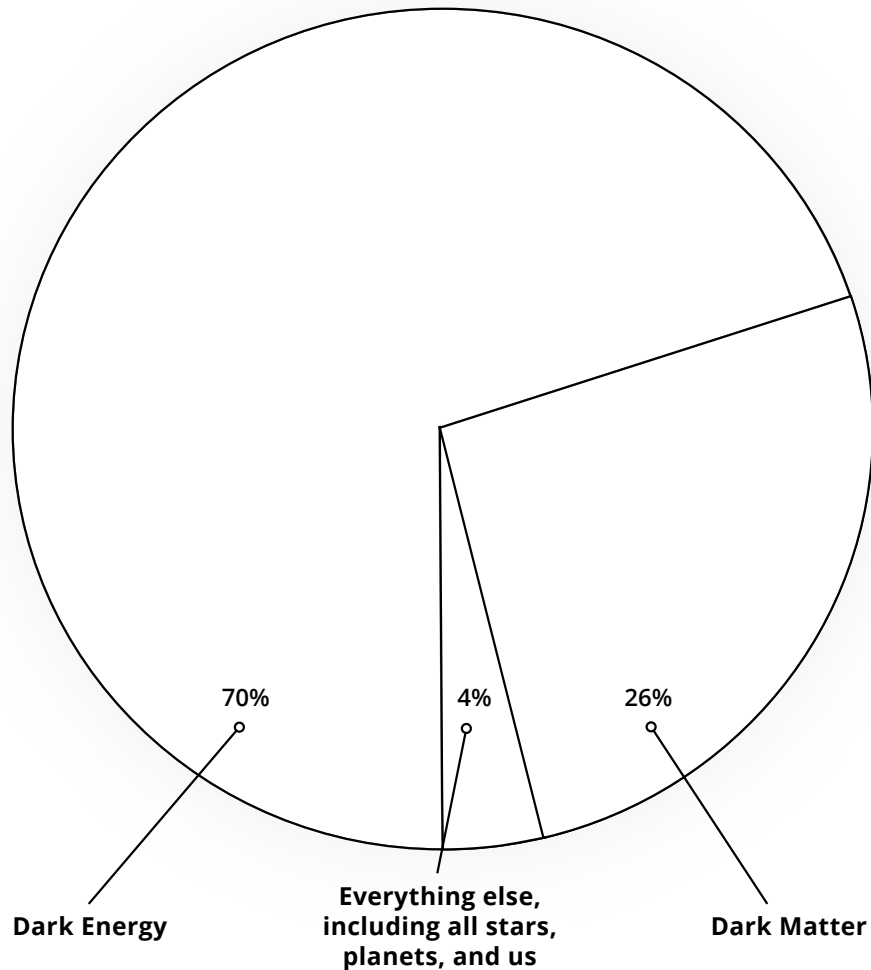
CLUSTERS OF GALAXIES



Astronomers and archaeologists (like real-life versions of Indiana Jones) have a lot in common, as they both look for clues to understand past events. However, while archaeologists have to dig deep underground to find fossils and ruins, all astronomers have to do is look up to the night sky. That's because when we look at objects in the night sky, we are seeing them as they looked when the light they gave off started its long journey across the Universe to us.

This means that each view of the Universe reveals a snapshot of the Universe's history. Take this picture, for example. It shows the aftermath of a collision between two huge groups of galaxies, which are called galaxy clusters. Following the collision, the galaxy clusters joined together to form what is now called the Bullet Cluster.

THE UNIVERSE



It's easy to assume that what we see and experience in our daily lives is 'the norm'. However, as astronomers learn more about our Universe, they're finding that sometimes the weird and wonderful stuff is actually more popular. For example, astronomers think there is about six times more invisible material in space than visible stuff! Astronomers call this invisible stuff 'dark matter'. Plus, there's even more mysterious stuff called 'dark energy' that seems to help drive the Universe apart.



Universe in a Jelly Bean Jar

The Universe then, is mostly dark: about 96% consists of dark energy (about 70%) and dark matter (about 26%). Less than 5% (the same proportion as the non-black jelly beans in the jar) of the Universe—including the stars, planets and us—is made of familiar atomic matter. X-rays can help reveal the secrets of the darkness. X-ray astrophysics is crucial to our understanding not only of the Universe we see, but the quest to determine the physics of everything.

EARTH TO THE UNIVERSE

S A R D N A H C W R
S U N K N A J I A W
R V P M J T Y I Y U
K E P E H V N M X N
H L T G R B N O A I
E C I S O N R O L V
E L X W U N O N A E
S T A R S L R V G R
L Q H U A G C M A S
O J N S I Y S G A E

CHANDRA

CLUSTER

GALAXY

LIGHT

MOON

RAINBOW

STARS

SUN

SUPERNOVA

UNIVERSE

XRAY

CONSTELLATIONS

Create your own constellations with the stars.

What does your Universe look like?

'Constellation'
is the name we give to patterns of stars in the night sky. Long before the invention of the telescope in the 1600's, early civilizations invented star patterns and named them after animals, objects, heroes, gods, and beasts from stories and myths. Many of these myths were probably created to explain changes in the sky due to seasons and other events.



[HTTP://CHANDRA.SI.EDU/KIDS](http://chandra.si.edu/kids)

[HTTP://WWW.UNAWE.ORG](http://www.unawe.org)