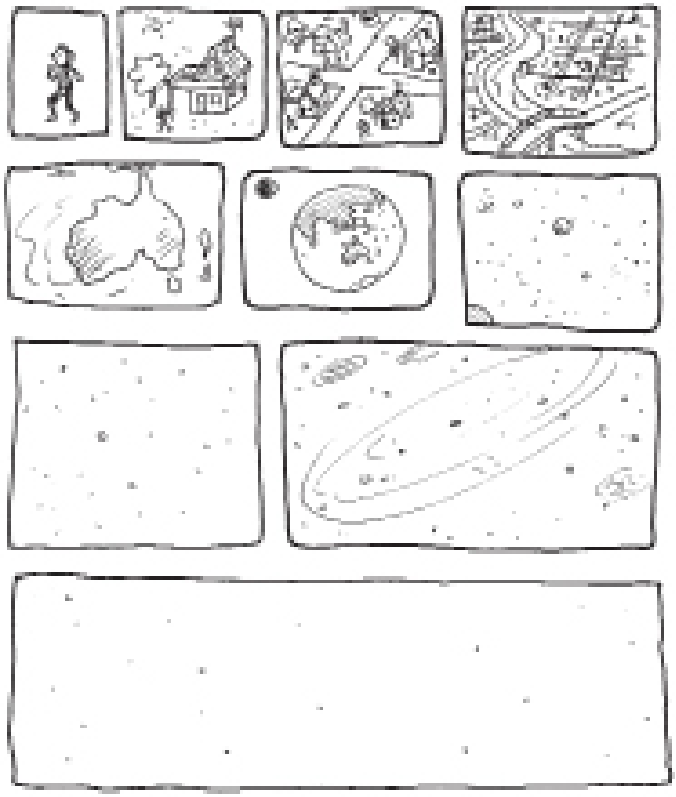
The Universe is everything
around you, beyond you, and

IT IS ALSO YOU . . .



The Universe is BIG.

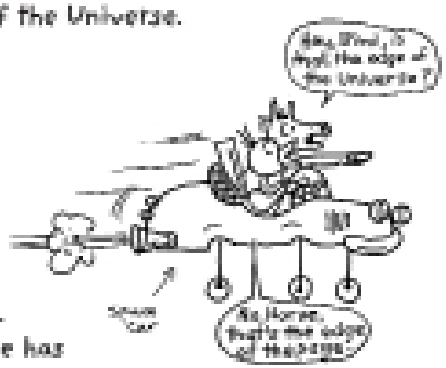
VERY BIG.

If you stood at the 'centre' of the Universe
the outer 'edge' would be an amazing
434,000,000,000,000,000,000,000 km away.

What a lot of kilometres!
That's why we say the Universe is

BIG!

If you had a space car that could travel at 1000 km
every second (THAT'S VERY FAST!) it would still take you
20,000,000,000,000 (20 trillion) years
to arrive at the far 'edge' of the Universe.



That's a VERY LONG TIME.
Far longer than the Universe has
been in existence.
And . . .
just to confuse you, no one knows if the Universe even has an 'edge'.
Most scientists think that the Universe just keeps wrapping itself
around itself and that it's getting bigger.
It might keep expanding forever.

Even the smartest people in the world don't know for sure.

What is the Universe made of?
The Universe is mostly made of

NOTHING.

In our small solar system
even the distances between the planets are huge.
In 1977, the Voyager 2 spacecraft began a journey passing
all the planets. It took 12 years to arrive at Neptune,
the farthest planet from the Sun.
It was travelling at 56,000 km every second.
THAT'S FAST!

So even our solar system is mostly

NOTHING.

In our galaxy, THE MILKY WAY, there are
over 400,000,000,000 (400 billion) stars.

In the whole Universe, scientists think there are more than
1,000,000,000,000,000,000,000,000 stars.

It's impossible to imagine that number.
Unless you go to a beach...
because a reasonable-sized beach will
contain as many grains of sand as there
are stars in the Universe.

FACT BOX

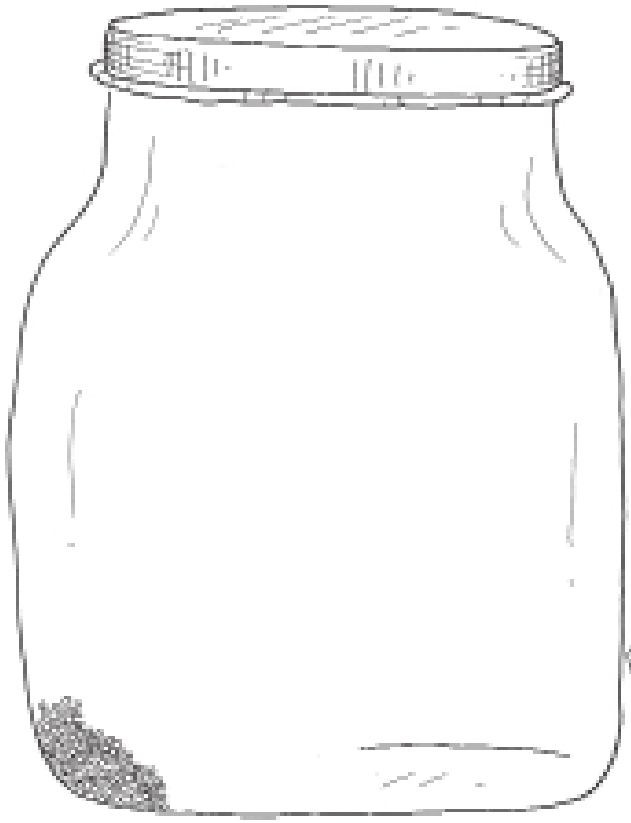
Stars are giant balls of gas held together by forces of gravity. The forces are enormous, pulling the gases tighter and tighter together. Eventually the atoms collapse and start a process called NUCLEAR FUSION. Fusion is two atoms joining together and throwing out energy. Most stars fuse hydrogen into helium. They radiate this energy as heat and light.

So, to sum up:

You → small

Stars → LOTS

The Universe → BIG!



There are 100 grains of sand drawn in this jar.

Imagine filling it with tiny drawings of grains of sand and keeping count as you draw. You would be amazed at how many it takes to fill the jar.

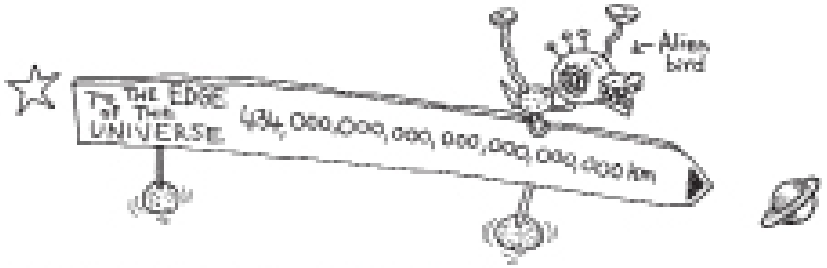
Our galaxy has tons AND TONS of stars,
but our solar system only has one . . .

THE SUN!

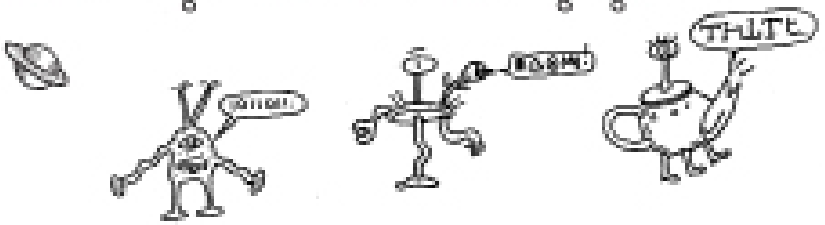
Astronomers know of more than 500 solar systems so far,
and they find new ones every year.

If there are more than 1,000,000,000,000,000,000,000,000 stars,
then there might be more than
1,000,000,000,000,000,000,000,000 solar systems.

Life needs a sun's heat and light to survive
so a planet like Earth MIGHT be circling one of those stars.
Another important ingredient is LIQUID WATER.
If Earth were closer to the Sun, like Mercury
or Venus, the water would boil.
A bit further away, and we would be an icy ball of rock like Mars.



Studying the light that comes from other worlds
tells scientists what gases and elements make up their atmosphere.
Water or oxygen would be good news.
But alien life might not look like we think it's going to . . .



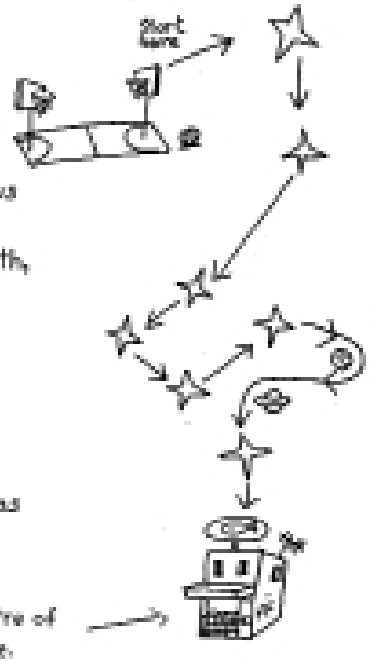
Twinkle, twinkle, little star!
Look up at the stars tonight – they really
do twinkle, but only when they're seen
from Earth. Out in space they just look like
round points of light.

As the starlight comes through the layers
of air and gas that surround our planet,
the light is bent and wobbled.

Soon you will know (almost)

EVERYTHING

there is to know about stars!



But all people USED to know
about them was that they could help us
tell the time of night.
And figure out where we were on Earth,
like a map in the night sky.

For thousands of years we
thought the Earth was flat.
Even 500 years ago we didn't know
that Earth revolved around the Sun.
And after that we thought the Sun was
the centre of the Universe.

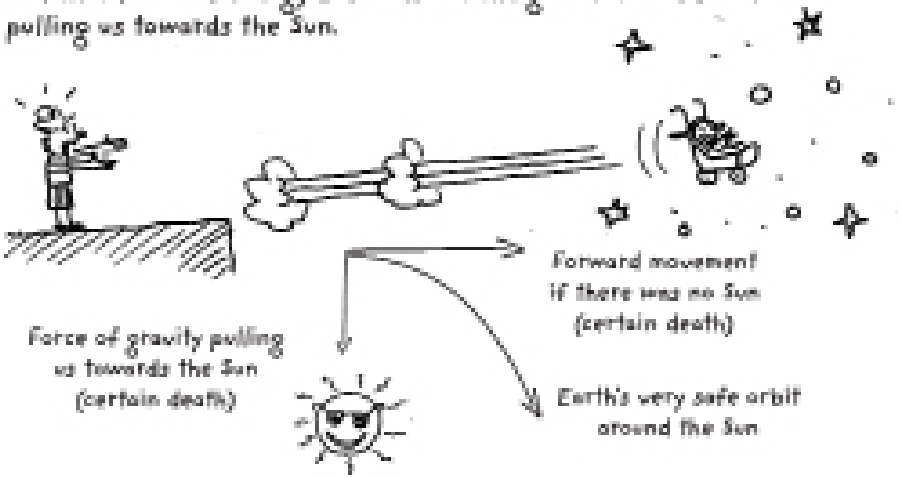
The star map to the centre of
YOUR whole universe.

FLYING VERSUS FRYING

The Sun was born from a GIANT spinning cloud of gas and dust called a NEBULA.
The nebula collapsed, and as it spun faster and faster it flattened into a disc shape, which is what our solar system looks like now.

The Sun formed at the centre and other bits came together around it to become the planets.
Stars have a powerful force called GRAVITY, pulling everything towards them.
So why doesn't Earth get pulled straight in and fried like an egg?

It's because Earth is also travelling FORWARD with a lot of energy, and that forward energy balances out the gravitational force pulling us towards the Sun.



If the Sun disappeared, Earth and all the other planets would zoom off in a straight line.
Off we would go into the cold dark NOTHING of space.

COMETS AND ASTEROIDS

We're joined in our journey around the Sun by lots of ASTEROIDS and COMETS.

Comets are made of ice, dust and rock.
You can sometimes see their TAIL, which is made of gas and dust.

Halley's Comet is a comet that passes Earth every 75 or 76 years.
It's been written about by historians and has appeared in art for thousands of years.

Asteroids are lumps of rock that travel around in space.
There are billions of them travelling around the Sun in a BELT between Mars and Jupiter.

Some are tiny, but some of the bigger, rounder asteroids get a promotion.
They're called DWARF PLANETS.

FACT BOX

When anything from space hits our atmosphere we call it a METEOR. Most meteors burn up and DON'T hit the Earth. We just see a streak of light in the night sky and we call it a falling star. A METEORITE is anything from space that actually hits the Earth's surface. A large meteorite might have been to blame for the extinction of the dinosaurs.

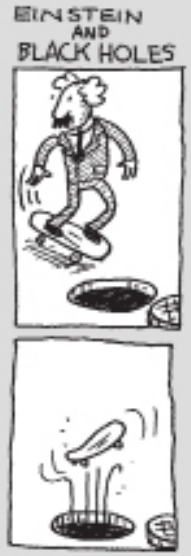
BLACK HOLES

. . . are strange and mysterious.

A brilliant scientist called Albert Einstein
predicted that they existed in 1916.
But astronomers didn't find one until 1971.

A BLACK HOLE is created from the core of a collapsed star.
They can be HUGE or tiny.
They have such powerful gravity that even light gets sucked in.

So you can't SEE a black hole.
Scientists know they are there because
of what happens to objects around them.
Sometimes there is an ACCRETION DISK, a glowing spiral
of gas and dust being sucked towards the hole.



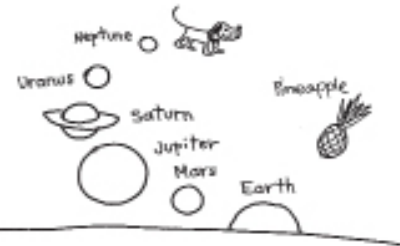
MOONS AND PLANETS

From Earth, the two brightest things in the night sky are the Moon and the planet Venus.

What's the difference between a moon and a planet?
MOONS revolve around planets and PLANETS revolve around stars. Easy!

FACT BOX

The Earth is on a slight tilt because a long time ago, when Earth was just a baby planet, something very big hit it and knocked it on an angle. Scientists think that the rubble that was thrown into space from that big hit might have been caught in our orbit and became our moon.

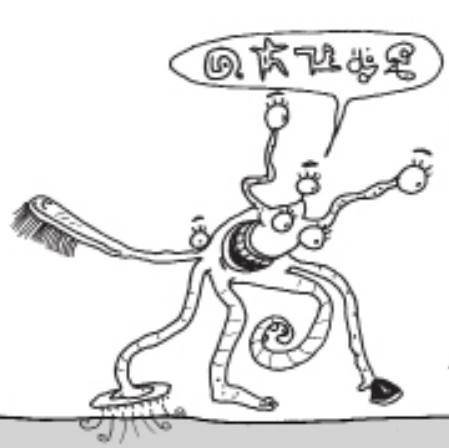


Not all moons are dead rocks.
Scientists have evidence that one of Jupiter's moons, Europa, has a giant saltwater ocean under its icy surface.
It also has a thin oxygen atmosphere.
In lots of ways it's more like Earth than the planet it revolves around.

But ANYTHING floating around in space can get caught in a planet's orbit and become a moon.

And moons can have things orbiting around them too.

There are eight big planets orbiting the Sun.
But there are other things as well, including all those asteroids and comets, and dwarf planets like Ceres, Pluto, Makemake and Eris . . .



Plus loads and loads of cosmic dust. Yes, that's really a thing!