

EU Universe Awareness



# Earth Ball

Activity Book





# INTRODUCING EARTH

## Earth facts

Age	4.5 billion years old
Diameter	12,742 km
Mass	5,974 million billion billion kg ( $5.974 \times 10^{24}$ kg)
Distance from Sun	150,000,000 km (1 astronomical unit)
Rotation period around own axis	23 hours 56 minutes (about 1 day)
Orbital period	365.24 days (about 1 year)
Temperature	Between $-90^{\circ}\text{C}$ and $60^{\circ}\text{C}$
Gravity	After 1 second, a falling object reaches a speed of 9.81 metres per second
Inclination rotation axis with respect to orbital plane around the Sun	23.4 degrees

## HI THERE

Let's get to know Earth! Everyone should know a bit about their home planet, and this book is a great way to get you started. So inflate your Earth Ball really well, and you are ready to go! But first:



What's your name?



## NAMING EARTH

Our planet is called Earth, but it also goes by other **names** and **nicknames**.



Which of the names below has NOT been used for Earth? Cross out the wrong ones!



What would YOU call Earth?

**Tip:** all the other planets in our Solar System are named after mythological beings. Maybe you can find one that could fit Earth?

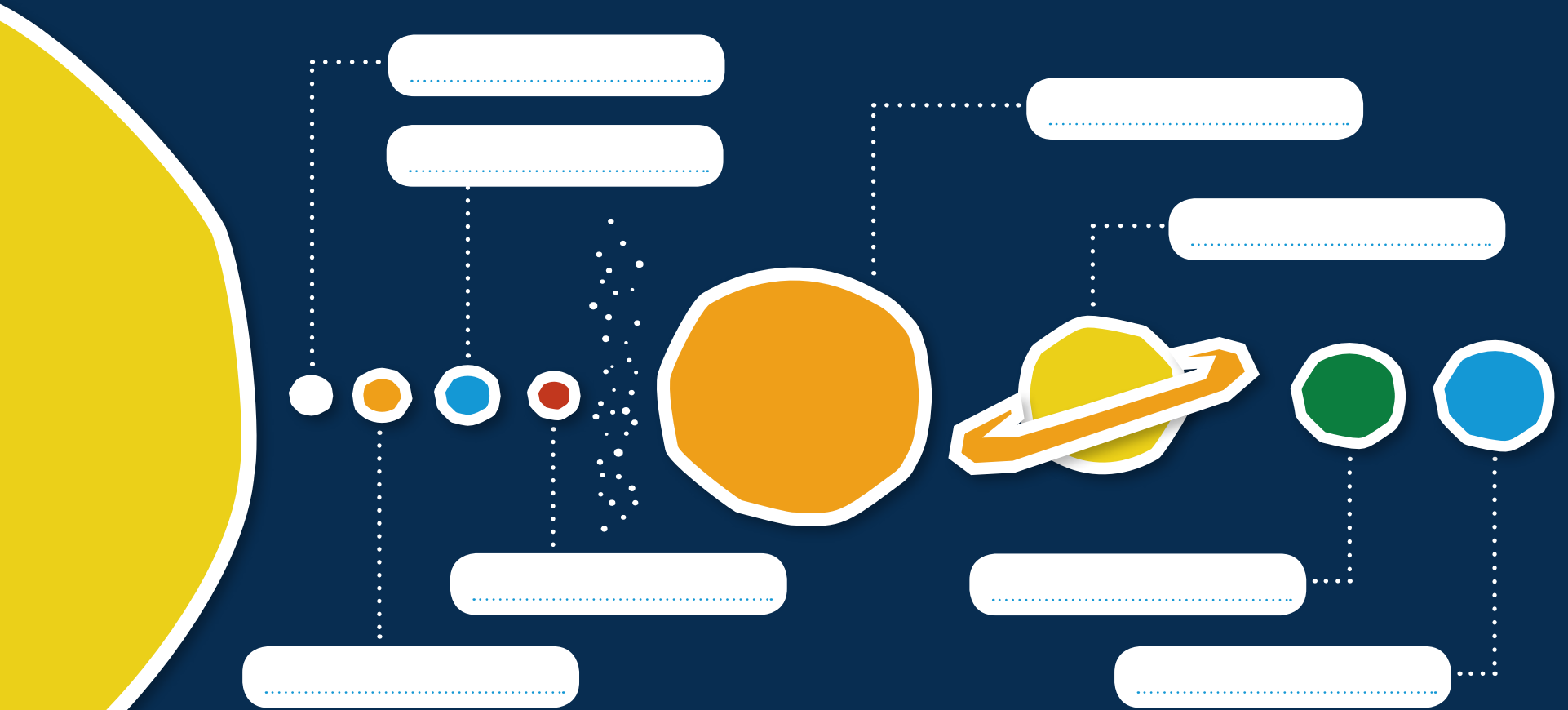
My name for Earth: .....

There are cutout figures at the back of the book!

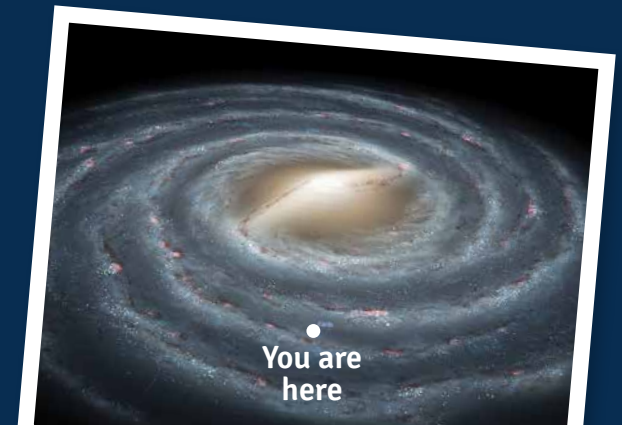
Get to know ...  
**YOUR PLACE IN  
THE UNIVERSE**

Earth is the 5th largest planet in our Solar System.

This is our **Solar System**:



And this is our galaxy, **the Milky Way**:



Can you name all the planets?



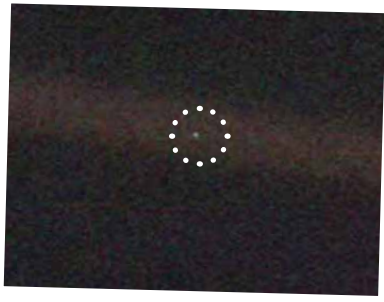
# SEEING EARTH

Looking at the Earth Ball, you are seeing Earth from afar, as if you were in outer space.



### EARTHRISE

was the first clear colour image of Earth taken from space. It was taken by the Apollo 8 crew in 1968.



### PALE BLUE DOT

is the photo of Earth taken farthest away from us, at 6 billion kilometres. It was taken by Voyager 1 in 1990 as it was leaving the Solar System.



How do these extraordinary views of our planet make you feel?

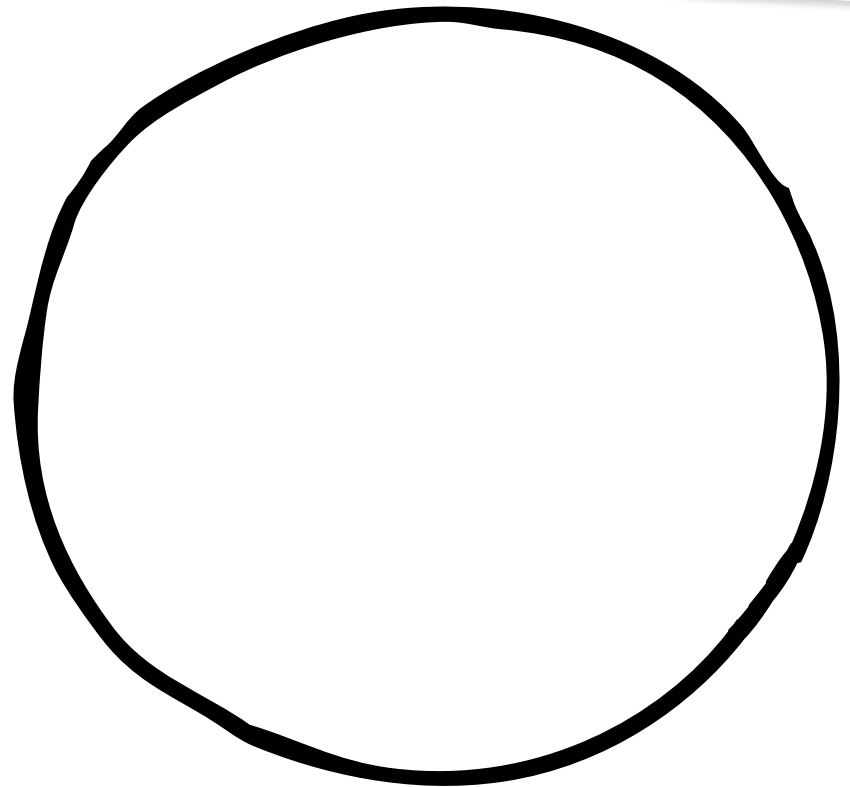
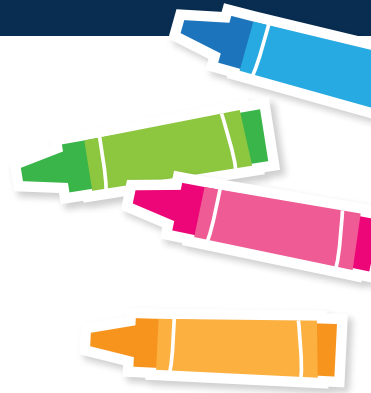
Circle all the fitting words or write down your own.

small protective curious disappointed giddy  
special excited  
far out lucky happy  
in awe sad  
alone humble  
proud lost adventurous angry weightless

You have to travel 19,312 km away from Earth to be able view the entire planet.

### REMEMBERING EARTH

Look carefully at the Earth Ball for a while, look away and try to make a drawing of Earth that is as **accurate** as possible. Then compare your drawing to the Earth Ball.



How close did you get? Did you miss something really obvious?



We haven't always viewed Earth as we do today. Our view of our planet has changed quite dramatically!

### THEN AND NOW

Below is an **old map** of Earth as it was believed to look in 1490.



Compared to the Earth Ball, does it look different? If so, what is different and why do you think that is?

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### OLD VIEWS

In the old days, it was believed that the Earth was **flat**. Deflate the Earth Ball and imagine what that would be like!



What would happen at the edge of a flat Earth?

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### ROUND OR FLAT

An easy way to see that the Earth is **round** is by watching a ship disappear over the horizon. Try moving a figure along a flat table and then along the Earth Ball.

You will need  
• a cutout figure



Can you see the difference?

On the Earth Ball, the ship seems to sink into the ocean. But if the Earth was flat the ship wouldn't sink as it moved away, it would just get smaller and smaller.





### How well do you know your home planet?

#### EARTH'S COMPOSITION

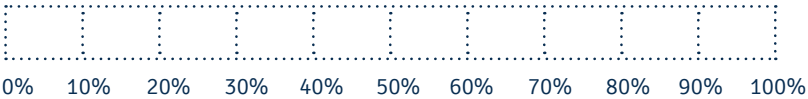


Do you think there is mostly **water** or **land** on Earth's surface?

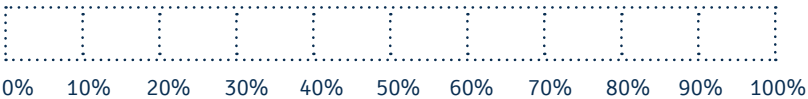
Use the Earth Ball to see if you can **estimate** how much there is of each. Fill the bar below with colours and ask a couple of friends or family members to do the same. Do you agree about the ratio?

Example:

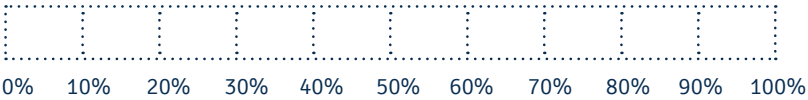
**You:**



**Friend 1:**

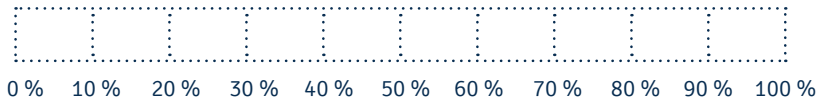


**Friend 2:**



Now find out what the ratio actually is and fill it out below!

**Actual ratio**



One-tenth of the Earth's surface is always covered with ice.

#### EARTH'S GEOLOGY

Find out what type of nature the different **colours** on the Earth Ball represent.



desert

forest

mountain

water

ice



Which 3 colours are most common?

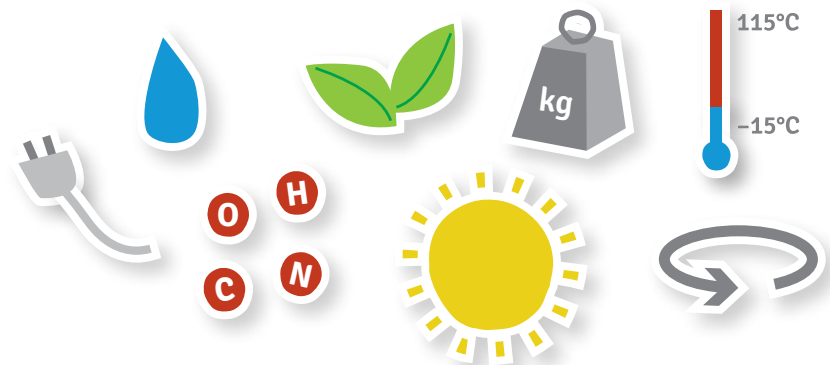
(Can you distinguish the white clouds from the white ice?)

#### A MATTER OF LIFE AND DEATH



Do you know what makes a planet habitable?

Circle the objects you think are necessary for life in the illustration:





The continents move a few centimetres every year!

### LOOKING CLOSER

Look closely at the Earth Ball to see if you can spot something you haven't noticed before.



What is it and where is it?



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Do you see something about Earth you are **curious** about? Ask someone you know if they can tell you about it, try figuring it out together or go online or to the library.

Curious about: .....

.....

What I found out: .....

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### SEEING THINGS

Look at the Earth Ball to see if you can find **features** that remind you of something else, for example, a mountain range that looks like a face. Ask a friend to see if he/she sees the same thing as you.



Who can find the weirdest looking thing?

I found:

Friend found:

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### COUNTING CONTINENTS

From space, Earth doesn't look **divided**. But for us, who live here, Earth is split into continents, countries, cities and so on. Look at the Earth Ball from different angles.



What's the largest number of continents you can see at the same time?

Number of continents: .....



Get to know ...

# EARTH'S MOTION

Earth orbits around the Sun at 29.8 km/s!

When you look outside, it seems like the Sun is moving around the Earth, but it's actually the other way around!

### You will need

- a compass
- adhesive putty
- toothpicks
- a bucket
- cutout figures

### DAY AND NIGHT

1. Place the Earth Ball in the bucket so that your **position** on Earth is pointing upwards.

2. Use the compass to make sure that the North Pole of the Earth Ball is pointing north and the South Pole is pointing south.

3. Put a cutout figure where there is **light** on the Earth Ball and another in the **shadow**.



4. Which person is sleeping and which one is having lunch? What do you think the time difference is?

5. Put adhesive putty on the end of some toothpicks and place them on the Earth Ball along the line where shadow and light meet. Observe how that **line** moves every few hours.

6. Does the line move from east to west?

- No, from west to east.
- Yes!



7. Does Earth rotate in the same direction as the shadowline moves, or the opposite?

- Same  Opposite



8. Where does the Sun set and rise?

Rises:  North  East  South  West

Sets:  North  East  South  West

9. Place a toothpick at your position. As the sun moves across the sky, observe how the shadow **moves** around the toothpick on your location.



10. When in the day is the shadow longest and shortest?

Longest: .....

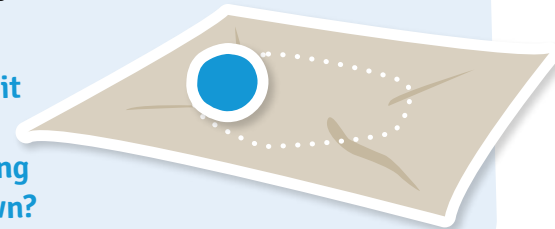
Shortest: .....

### AROUND THE SUN Game

Hold up a blanket with your friends and put the Earth Ball on it.



11. Can you make it move in a circle by moving the blanket up and down?



There's more on the next page!





## THE SEASONS

Every year, Earth goes through its seasons. But they are not caused by Earth's varying distance from the Sun as it moves along its orbit. So why do we have them?

### You will need

- a flashlight
- adhesive putty
- toothpicks
- a bucket

1. Put a toothpick with adhesive putty on the North Pole, representing Earth's **rotational axis**, and place the ball in the bucket so that the North Pole points directly upwards.

2. Then **tilt** the ball about 23° to the side. This is actually how Earth moves through space!

3. Turn off the lights in your room and point the flashlight (the Sun) towards the Earth. Walk around the Earth Ball in a **counterclockwise** direction

while pointing the flashlight directly at Earth, simulating how sunlight hits the Earth throughout the year.



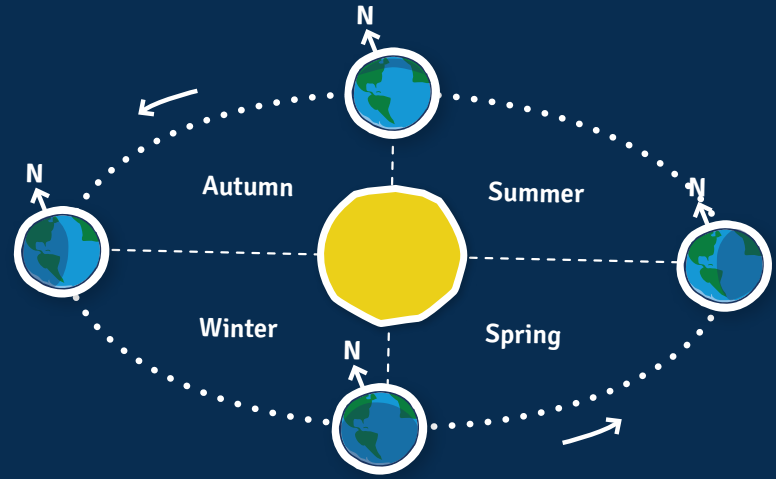
### Where is it summer and where is it winter?

**Tip:** Observe how the hemispheres are tilted towards and away from the Sun!

For more details and activities about day and night and the seasons, check out the book "Parallel Earth": [http://es.unawe.org/resources/books/Parallel\\_Earth](http://es.unawe.org/resources/books/Parallel_Earth)

Earth follows an elliptical—but very close to circular—path around the Sun.

**Below:** Earth's motion around the Sun through the course of a year.



### Do you think we would have seasons if Earth's rotational axis wasn't tilted?

**Tip:** Point the rotational axis directly upwards and point the flashlight towards it again to see what happens!

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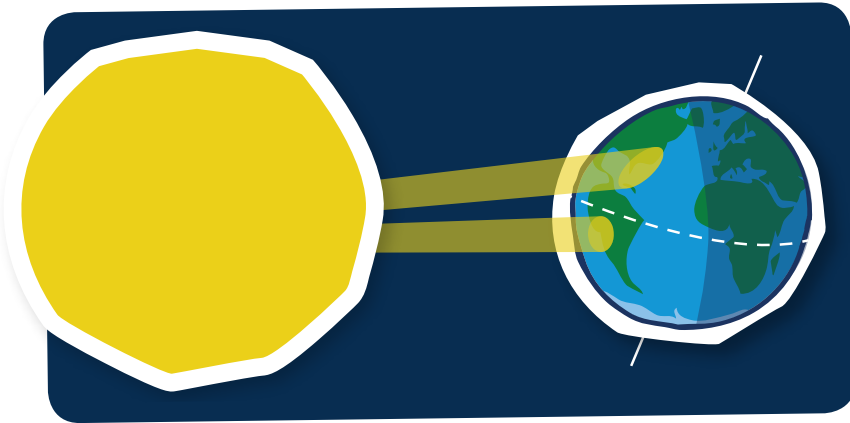
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There's more on the next page!



During the year, the continents change their position relative to the Sun, making the sunlight hit the ground at different **angles** as time goes by. Because of the different angles, the ground warms up at different intensities, which also affects the seasons!



**Which of the two yellow circles in the illustration above do you think is the warmest?**

**Tip:** Notice that the light has to travel different distances in the two cases!

The top one

The bottom one



**What do you expect the season to be in the two areas hit by the sunlight in the illustration above?**

**Top area:** .....

**Bottom area:** .....

Some countries only experience two or three seasons, while others experience all four seasons.

## UPSIDE DOWN УБЪИДЕ ДОМЪИ



You are probably used to seeing Earth **oriented** a specific way, either the North Pole pointing upwards or the South Pole. If you live in the Northern Hemisphere, you are probably used to seeing the top version to the right.



**Which is right? Is there even a right way to look at it? Can we talk about up and down in space? Why doesn't a person standing at the bottom fall off?**

**Tip:** It has something to do with gravity!

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How extreme is Earth? Find out how the scales on Earth are compared to the rest of our Solar System!

## THE TALLEST MOUNTAIN

### Earth

Mount Everest, Asia

Height: 8.8 km

### Solar System

Olympus Mons, Mars

Height: 21.9 km



That's almost **2.5 times higher** than our tallest mountain!

## THE LARGEST CRATER

### Earth

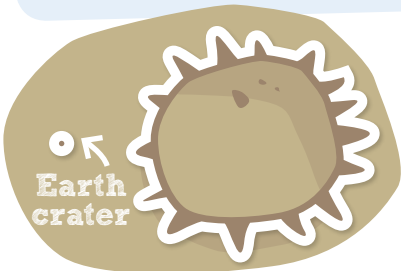
Vredefort, South Africa

Width: 300 km

### Solar System

North Polar Basin, Mars

Width: 10,600 km **Most extreme!**



That's over **35 times larger** than our largest crater!

## THE LONGEST RIVER

### Earth

The Nile, Egypt

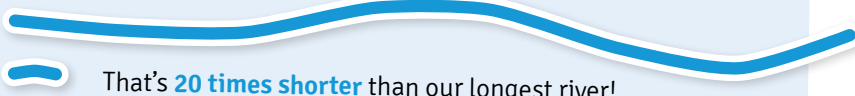
Length: 6,650 km

**Most extreme!**

### Solar System

Titan (moon of Saturn)

Length: 320 km



That's **20 times shorter** than our longest river!

## THE HIGHEST AND LOWEST SURFACE TEMPERATURES

### Solar System

Venus

Temperature: 462°C

**Most extreme!**

### Earth

California, USA

Temperature: 56.7°C

Venus is **eight times hotter** than our warmest place!

### Earth

Antarctica

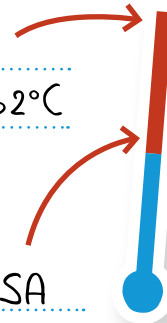
Temperature: -89.2°C

### Solar System

Our Moon!

Temperature: -240°C

The Moon is almost **three times colder** than our coldest place!



**Most extreme!**



Can you find all the locations on the Earth Ball? Are any of these objects visible from space?

## THE LARGEST MOON

### Earth

Moon

Radius: 1,737.1 km

### Moon



Ganymede



### Solar System

Ganymede, Jupiter

Radius: 2,634.1 km

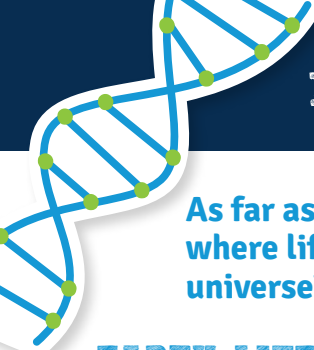
Ganymede is only **1.5 times larger** than our Moon.

**Most extreme!**



Can you see the Moon tonight? If not, why is that?

# LIFE

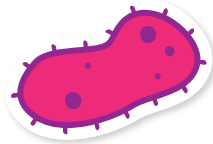


As far as we know, Earth is the only place where life exists. But are we alone in the universe?

## EARTH LIFE



Where on Earth can you find an astounding number of plants and animals living together? Can you find them on the Earth Ball?



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## ALIEN LIFE

Several Earth-like planets have been discovered in our galaxy.



Do you think there is more life out there?

Yes!

No!

I don't know what to believe ...



There are an estimated 8.74 million species on Earth.

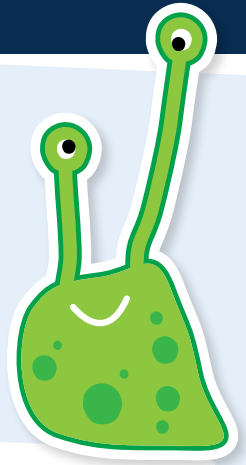
## IMAGINE AN ALIEN

Try to imagine what life on a different planet might be like and look like.



Do you think they would look like and be like you?

**Draw** your best guess and colour it!



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## My Alien

Name: .....

Age: .....

Height: .....

Likes: .....

Dislikes: .....



# VISITING EARTH

## EARTH TRAVEL

Going on a **trip**? Take the Earth Ball with you and **photograph** yourself with it, pointing the correct destination towards the camera. Make a little mark on the Earth Ball showing all the places it has been.



Paste your best vacation photos here!



Giza, Egypt



Pisa, Italy



Easter Island

## TOUR GUIDING



If aliens were to visit Earth, where do you think they would land? What would you like to show them?

Destination #1: .....

Destination #2: .....

Destination #3: .....

## My day travelling with the aliens

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# LOVING EARTH

Earth is the only home we've got. Everything you have experienced, everyone you know—it's all here! That makes Earth pretty special, doesn't it?

## TOP 3

Try figuring out what your **favourite things** about Earth are!



### My favourite things about Earth



1. What: .....  
Why: .....  
.....



Is your favourite thing about Earth something nature-made or man-made, big or small? Why do you like it?

Take pictures and paste them on top of the circles or make drawings inside them.

2. What: .....  
Why: .....  
.....  
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3. What: .....  
Why: .....  
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# VISITING EARTH PART 2

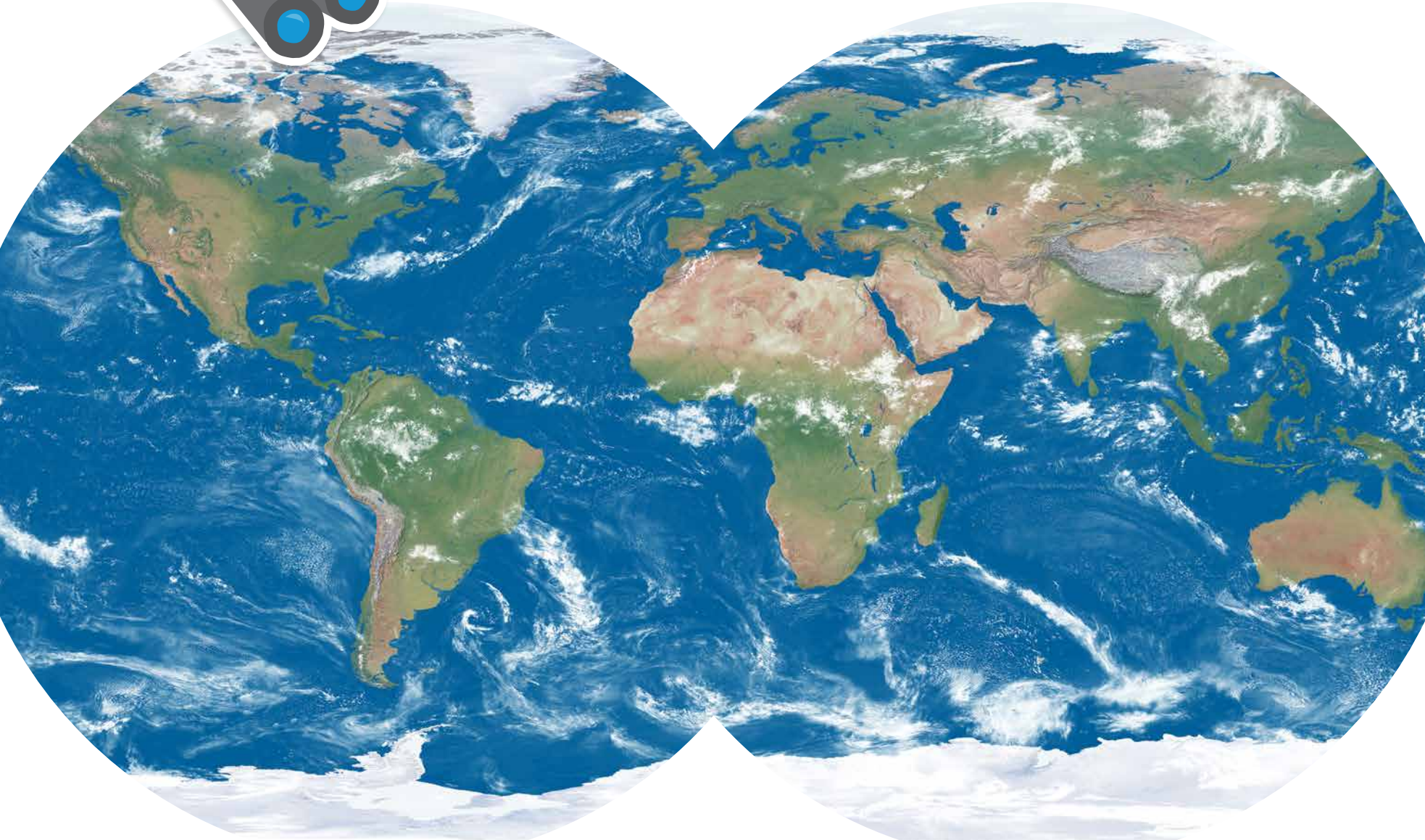
Some people believe we have been visited by aliens! There are even websites where you can report your sightings.

Imagine you were the very first person to discover Earth, travelling to our Solar System from a distant planet.



How would you divide the countries, continents and oceans? What would you name them?

Add your own borders and names on the map below!



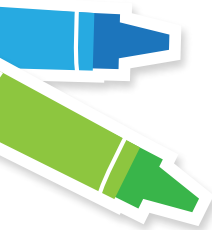


# IMAGINE A DIFFERENT EARTH

Can you imagine the Earth being different than it is? Let's try!

## OPPOSITE EARTH

**Colour** this drawing of Earth, but switch where the water and the land is! Compare it to the Earth Ball.



On which Earth would you rather live?

Regular Earth

Opposite Earth

If Earth didn't rotate, a day would be as long as a year!

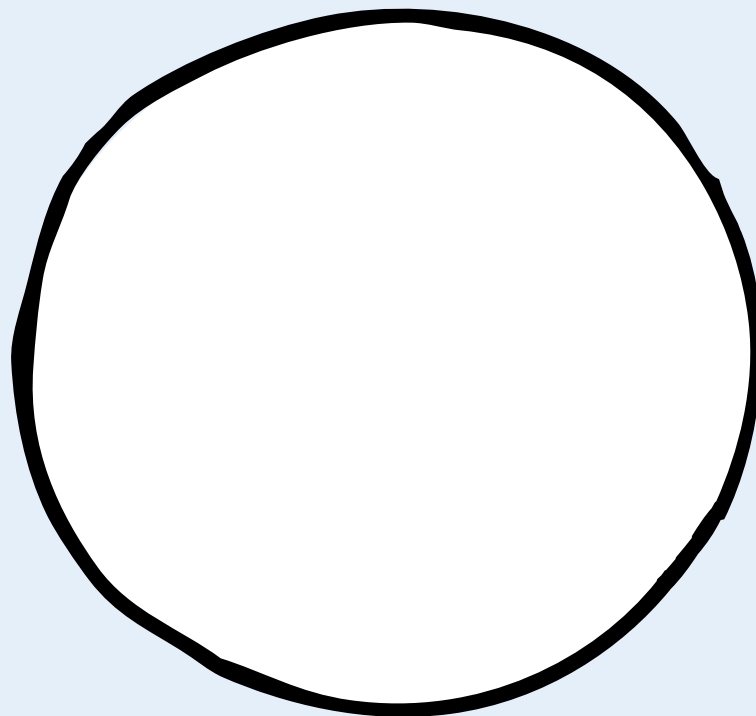
## DESIGN YOUR OWN EARTH

Use the blank circle below to design your very own Earth!



What would you change about Earth and why?

Four horizontal dotted lines for writing.







# VISITING EARTH PART 3

## THE SHAPE OF EARTH

You might think that Earth is completely **spherical**, but it's actually wider along the equator.



Which of the shapes to the right do you think is closest to Earth's actual shape? Circle your best bet!



Do you know why Earth is wider along the equator?

**Tip:** It has something to do with how Earth moves!

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Show and explain the reason for this shape to someone using the Earth Ball.



Can you think of a place on Earth that, in any way, is the **opposite** of where you live?

**Tip:** It can be opposite in hemisphere, temperature, type of nature, etc.

Place: .....

## AROUND THE WORLD Game

Let's **travel** around the world! First, make a die out of paper. On each side write a motion like left, upward, backward, north, etc. Combine this die with a regular die, where each number represents a distance: one fingerstep, two fingersteps and so on.

### The game

- find your hometown on the Earth Ball
- throw the dice 10 times. For each throw, follow the instruction on the dice, using your fingers to move around the globe.



How far can you go in 10 throws? Where do you end up? Play with your friends and see who can get the farthest away from home!

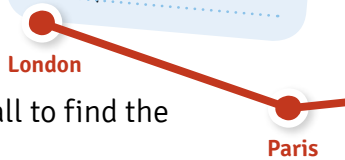


## GOING THE DISTANCE

The Earth Ball is a tiny **model** of Earth—Earth is 31,855,000 times bigger! This means that 1 cm on the Earth Ball represents 318.6 km on the real Earth. So you can use the Earth Ball to find the actual distance to different places!

### You will need

- measuring tape



From your hometown, what is the farthest distance you can go before you have circled the globe and start travelling back again?

The longest distance: .....

Destination: .....



Get to know ...

# THE MOON

The Moon is Earth's only natural satellite. It is 1/4 the size of Earth, and it orbits about 384,400 km away.

### You will need

- grapefruit (or similar sized object)
- measuring tape
- flashlight/lamp



**Above:** A scale model of the Earth and the Moon showing their relative sizes and the average distance between them.

### ORBIT



How far away from the Earth Ball would you have to place the Moon for the distance to be correct?

Distance: ..... m



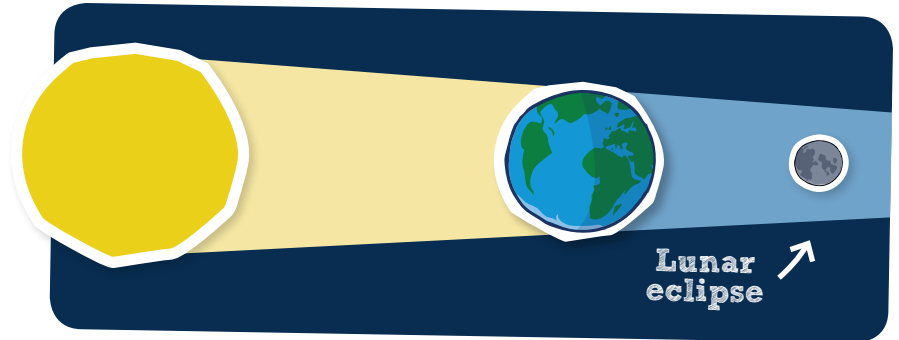
### PHASES

From Earth, we observe that the Moon has phases, which means that the amount of the Moon's surface we see illuminated varies over time. Find a dark place and put on a little light (representing the Sun). Then move the Moon around the Earth Ball.

It is believed that the Moon was formed as a result of a giant impact, where a Mars-sized body collided with Earth.

### MAKE A LUNAR ECLIPSE

Find a dark room and shine a light on the Earth Ball while moving the Moon behind Earth where there is shadow, as in the illustration below. You have now created a lunar eclipse!



If you want to see a real one: they occur two to three times a year.



Can you see why the Moon has phases?

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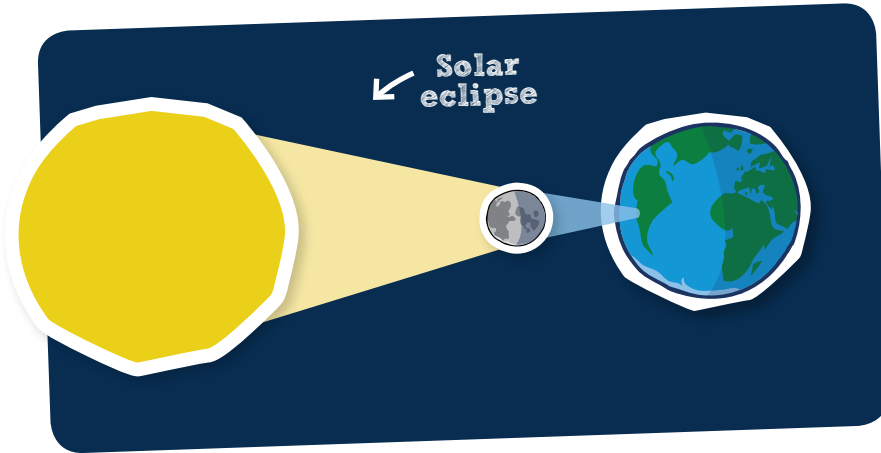
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## MAKE A SOLAR ECLIPSE

A solar eclipse is pretty similar to a lunar eclipse, but now the Moon is moving in the **light** instead of the shadow, which means the Moon is now casting a shadow on Earth!



**Can you see why a lunar eclipse is observable by many more people than a solar eclipse is?**

**Tip:** Compare the illustration of the solar eclipse and the illustration of the lunar eclipse (previous page)!

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## Earth

### EARTH TOSS Game

Your friends probably know lots of stuff about Earth that you don't, and the other way around. Here's a game you can play to make **teaching** each other about Earth fun!

Gather your friends in a circle and throw the Earth Ball around. You can play this game many ways, so here are some examples. When a person catches the ball:

- **Example 1:** the person who caught it shares a fact about Earth and can then throw the ball to the next person.
- **Example 2:** the person who threw the ball asks a question about the Earth to the person who caught it. When he/she has answered, he/she will throw the ball on to the next person who will get a new question. If he/she is unable to answer, the person can pass the ball, and the question, to the next person.
- **Example 3:** the person who caught the ball names a planet, starting with the one closest to the Sun, moving outward in the Solar System with each toss. You can go through all the planets several times. Each time the Earth comes up, the person with the ball has to share a fact about Earth. (You can also include facts about the other planets if you'd like.)



**Did you learn something about Earth you didn't know before?**

Yes!

No ...



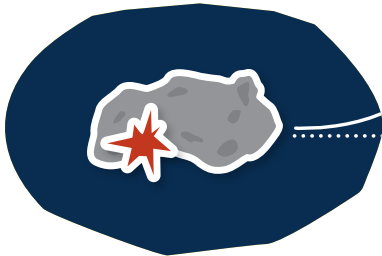


# PROTECTING EARTH

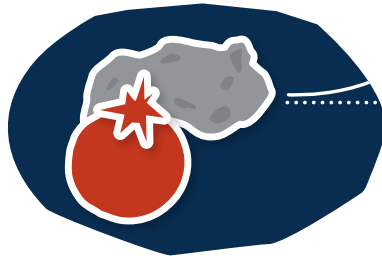
An estimated 500 small meteorites hit Earth's surface everyday! As long as they are small they aren't dangerous. But what if a big one comes? Are we prepared?

## PROTECTING EARTH

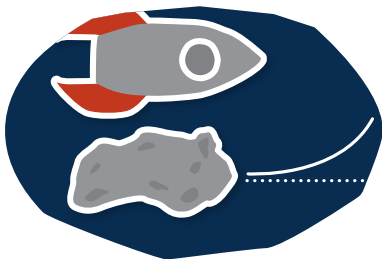
There are many proposed **methods** for protecting Earth from being hit by an asteroid. Here are some of them:



1 Initiating a **nuclear explosive device** on surface of the asteroid to deflect it.



2 Hitting the asteroid with a **massive object** to knock it off its course.



3 Placing a **large spacecraft** nearby and use the spacecraft's gravitation to steer the asteroid away from its course.



4 **Shooting lasers** at the asteroid to pulverise the surface, ejecting tiny bits of rock that could act as a propellant to nudge the asteroid off its course.

Scientists believe that an asteroid or comet impact made the dinosaurs extinct.



Which method do you think would work best?

Method:

1

2

3

4

## My big plan

Try to come up with your own plan to protect Earth!

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## COLLISION

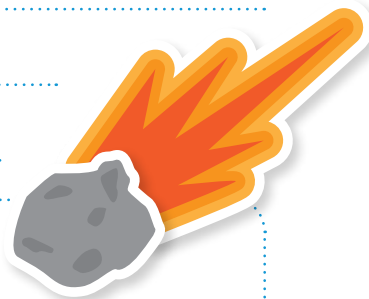


Where on Earth do you think it would be safest for a large meteorite to hit Earth? Why do you think so? What do you think would happen?

Where: .....

Why: .....

What: .....



## THE MAN IN THE MOON

From Earth we can only see one side of the Moon because it's always facing us the same way.



Why do you think that is?

Tip: It has something to do with its rotation!

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.....

Draw a smiley **face** on your Moon model (a grapefruit) and move it around the Earth Ball. Always keep the Moon smiling towards the Earth to see how this works in action!



The dark pattern gives the illusion of a face.



Can you see the Man in the Moon? Or do you maybe see something completely different?



# LEAVING EARTH

Since 1957, we have explored outer space, reaching farther and farther with our satellites, and we've even had people walking on the Moon. Do you think we will someday leave Earth altogether?

## GETTING READY FOR TAKEOFF

Cape Canaveral in Florida, U.S. is famous for being the **rocket launch site** for the Apollo missions.



Can you find it on the Earth Ball?

## DESTINATION ANYWHERE

Imagine that you had your own **spaceship** and could go on a mission anywhere in the Universe.

Destination: .....

Why, and what will you do there: .....

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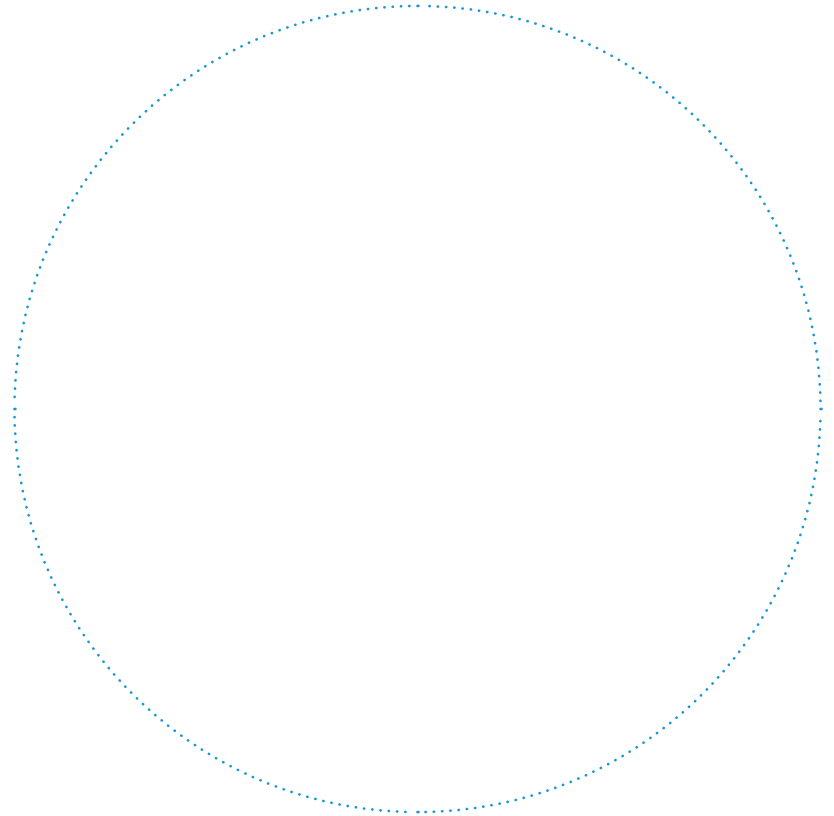
A trip to Mars takes around seven to eight months. Imagine how long it would take to travel further!



What would you call your **mission**?

My mission name: .....

Every mission has its own **seal**. Draw yours below!



**Tip:** Mission seals usually include the name of the mission, astronauts' names, a depiction of the destination, colours or symbols that represent the nationality of the mission and then some extra artistic stuff. Be creative!



# LEAVING EARTH PART 2

As of January 2013, a total of 530 people from 38 countries are known to have gone into space.



## REACHING OUTER SPACE

Outer space is defined as 100 km above Earth's surface.



How far do you think it is to outer space on the scale of the Earth Ball?

Distance: ..... cm



Would you want to return to Earth after your amazing journey? Why/why not?



outer space

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## DEAR EARTH ...

Even if leaving Earth sounds cool, you probably will miss something about it after a while. Write Earth a **poem** celebrating its wonderfulness! Try to mention the things you like most about Earth.



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# ABC

## EARTH ABC

You have now hopefully learned lots of things about Earth. So you are ready for this last assignment! For each letter in the alphabet, find a word you **associate** with Earth, like A is for atmosphere, B is for borders, etc.

**A** .....

**N** .....

**B** .....

**O** .....

**C** .....

**P** .....

**D** .....

**Q** .....

**E** .....

**R** .....

**F** .....

**S** .....

**G** .....

**T** .....

**H** .....

**U** .....

**I** .....

**V** .....

**J** .....

**W** .....

**K** .....

**X** .....

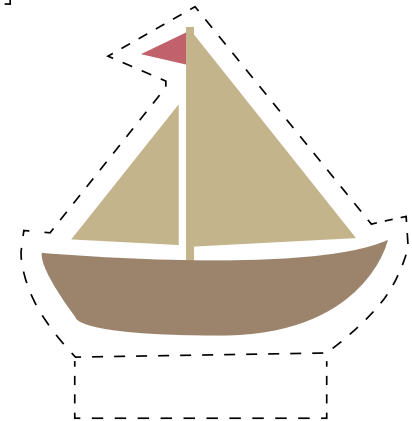
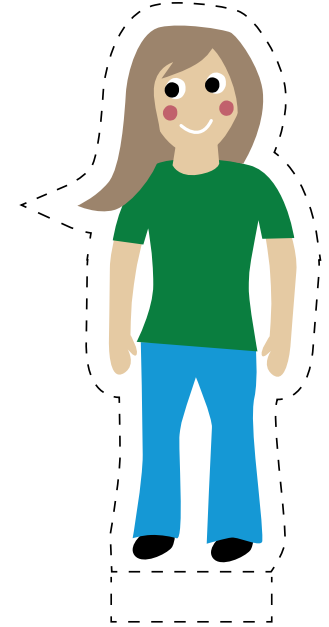
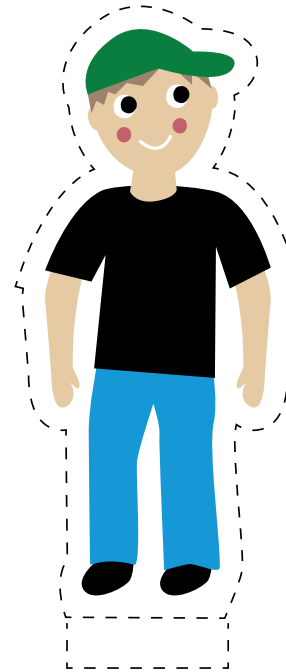
**L** .....

**Y** .....

**M** .....

**Z** .....

Here are some cutouts you can use for the various activities or to play around with!



## Scaled Solar System to the Earth Ball

Object	Original size (km)	Scaled size (cm)
Sun	1,391,000	4,367
Mercury	4,879	15.3
Venus	12,104	38
Earth	12,742	40
Moon	3,474.2	10.9
Mars	6,779	21.3
Jupiter	139,822	439
Saturn	116,464	366
Uranus	50,724	159
Neptune	49,244	155
Distance Earth-Moon	384,400	1,207
Distance Earth-Sun	149,597,871	469,621
Outer space	100	0.3

(Sizes are given as diameters.)

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