

KS2

STARGAZING LIVE.

LESSON PLANS

BBC
TWO



INTRODUCTION

Stargazing LIVE on BBC Two, presented by Professor Brian Cox and Dara O Briain, brings us the wonders of the galaxy and reveals the mystery of the stars. Many children are fascinated by space, and epic images from the world's best telescopes combined with the excitement of a live event will undoubtedly inspire many more.

To help capture this excitement and use it to motivate students, Blue Peter has produced a series of six 'Stargazing Challenge' films in which children work together with Bang Goes the Theory's Jem Stansfield and Helen Czerski to discover the answers to key questions about the universe, including 'Why do we have Seasons?' and 'Why does the Moon appear to change shape in the sky?'. Stargazing LIVE has produced this pack of six lesson plans to accompany the films.

Each lesson includes the film, engaging practical activities for children and clear explanation about the best way to deliver the lesson. The lessons are designed to be used either separately or in sequence in the order presented in this pack. The films are available at bbc.co.uk/stargazing under the Schools tab and on the BBC Learning Zone Class Clips website, bbc.co.uk/learningzone

The challenges at the start of each film, set by Blue Peter presenters Barney Harwood and Helen Skelton, are also available separately, meaning you can show them to your class and discuss how to solve the challenge before watching the full film.

This pack is only one part of the Stargazing LIVE offer for schools for 2012. Go to bbc.co.uk/stargazing and click on the Schools tab to watch animated astro answers to questions including 'How big is the biggest star?' and to find out how young people made their own music track using sounds collected from the Lovell Radio Telescope at the home of Stargazing LIVE, the Jodrell Bank Observatory in Cheshire. There are also a series of films featuring inspirational space professionals, Jobs with the Stars.

ORDER OF LESSON PLANS IN PACK

- 1 Earth, Sun and Moon Scale Model
- 2 Earth, Sun and Moon Orbits
- 3 Phases of the Moon
- 4 The Seasons
- 5 Rockets
- 6 Telescopes

WORKSHEETS

Worksheets to accompany the lesson plans are included at the end of this pack.

UNDERSTANDING THE NUMBERS

Before you start it is worth reflecting on the sense of sheer amazement that the topic of space can generate in a classroom. The Sun is so large that the Earth would fit inside it more than a million times. There are more than 100 billion stars in our galaxy and more than 100 billion galaxies in the universe.

Some of these numbers are so large that they seem to lose their meaning. To help children gain a sense of perspective, ask them about counting.

- Estimate how long it would take you to count to 1,000 – about 12 minutes.
- How long would it take you to count to a million? If you were to count at a speed of one number per second for 10 hours every day, counting to a million would take you about three weeks.
- If you think that's a lot of counting, to get to a billion you could count for 12 hours every day and it would still take you more than 50 years.

100 billion? Let's not even start...

But don't forget that the universe is so amazingly huge that despite the trillions of stars it contains, it is almost completely empty. The distances between the stars are inconceivably large and the distance between galaxies even bigger.

NUMBER DEFINITIONS

- A billion is 1,000,000,000 – a thousand million.
- The British definition for a billion used to be 1,000,000,000,000 – a million million but this number is now referred to as a trillion.

CURRICULUM LINKS

The six Stargazing LIVE Stargazing Challenge films and accompanying lesson plans create learning opportunities linked to the National Curriculum. References are to the Key Stage 2 National Curriculum for England © Q.C.A. 1999.

LESSON PLAN 1: SCALE MODEL OF THE EARTH, SUN AND MOON

Sc4 Physical Processes
4 The Earth and Beyond, 4d



“...that the Earth orbits the Sun once each year, and that the Moon takes approximately 28 days to orbit the Earth.”

LESSON PLAN 2: EARTH, SUN AND MOON ORBITS

Sc4 Physical Processes
4 The Earth and Beyond, 4c, 4d.



“...how day and night are related to the spin of the Earth on its own axis.”

LESSON PLAN 3: PHASES OF THE MOON

Sc4 Physical Processes
4 The Earth and Beyond 4d.



LESSON PLAN 4: THE SEASONS

Sc4 Physical Processes
4 The Earth and Beyond 4d.



LESSON PLAN 5: MAKING ROCKETS

Sc4 Physical Processes
2 Forces and motion 2b, 2e.



“...that objects are pulled downwards because of the gravitational attraction between them and the Earth.”

“...how to measure forces and identify the direction in which they act.”

LESSON PLAN 6: TELESCOPES

Sc1 Scientific Enquiry
Investigative Skills 2l.

Sc4 Physical Processes
3 Light and Sound 3d.



“... use scientific knowledge and understanding to explain their observations, measurements or other data or conclusions.”

“...that we see things only when light from them enters our eyes.”

SCALE MODEL OF THE EARTH, SUN AND MOON

🕒 1 HOUR

OBJECTIVES:

- To know that the Sun, Earth and Moon are approximately spherical
- To know their relative sizes and the relative distances between them

CHILD FRIENDLY OUTCOME:

- To describe the shape and the size of the Earth, Sun and Moon and how far apart they are in space

🎬 FILM CLIPS:

- Stargazing LIVE 'Stargazing Challenge' film 1 – Scale Model of Solar System using fruit
- BBC Learning Zone Class Clip 1589 (Images of the Earth, Sun and Moon)

RESOURCES:

- Sticky notes
- A selection of spheres of different sizes e.g. beach ball, football, tennis ball, ping-pong ball, marble, peppercorn, coriander seed, tiny beads
- Sticky tack



TO ACCOMPANY FILM 1: SCALE MODEL OF SOLAR SYSTEM USING FRUIT

INTRODUCTION

- 🎬 Show a video montage about space such as BBC Learning Zone Class Clip 1589 (a compilation of images of the Earth, Sun and Moon, set to music)

Ask three or four children to tell the class an interesting fact they know about the Earth, Sun or Moon (for example it takes eight minutes for light to reach the Earth from the Sun).

Ask the children what they would like to find out about the Earth, Sun and Moon. Then ask them to write questions on sticky notes and stick them to a class questions poster. Read out some of the questions.

ACTIVITY

Ask the children in groups to put the Earth, Moon and Sun in order of size by choosing from a range of spheres e.g. beach ball, football, tennis ball, ping-pong ball, marble, peppercorn, coriander seed, tiny beads. Do the children understand that the Sun is larger than the Earth and that the Moon is smaller?

Choose the largest sphere and explain that it represents the size of the Sun. Ask the children to suggest which sphere might represent the correct size of the Earth and then which might represent the size of the Moon.

(For a 60cm beach ball Sun, the Earth is a blueberry and the Moon is a coriander seed or tiny bead. For a 30cm football sized Sun, the Earth is a coriander seed or tiny bead and the Moon a tiny piece of sticky tack.)

Ask the children to hold the Earth and the Moon stuck on the end of pencils using sticky tack. Ask a third child to hold the Sun. Then ask them to stand in the classroom to show how far apart the Earth, Sun and Moon are.

(For a 60cm beach ball Sun, the Earth is 35m away and the Moon is less than 1mm from the Earth. For a 30cm football sized Sun, the Earth is 12m away and the Moon is less than 1mm from the Earth.)

For effect, repeatedly ask the child holding the Sun to move back towards the classroom door until they have to open it and step outside. Alternatively take the class outside, or to the school hall, to demonstrate these distances.

Note: The children will probably be surprised by the huge distances compared to the small size of the Earth. You could explain that space is called space because there is so much space out there. Explain that it took astronauts three days to get to the Moon and it would take several months to get to the Sun even in a rocket travelling at over four miles every second.

FORMATIVE ASSESSMENT

Give the children long thin strips of paper e.g. A4 cut into quarters lengthways. Ask them to make a quick sketch of the Earth, Sun and Moon. Do the sketches show that the Earth and Moon are much smaller than the Sun and that they are very far away?

PLENARY

Neptune, the furthest planet from the Sun, is 30 times further away from the Sun than the Earth is. Challenge the children to use this fact to work out how big a model of the whole Solar System would be on the scale used. Explain that one way around this problem is to scale down the distances between the planets but keep the planets to a different larger scale. Explain that this is what has been done in this video.

 **Show Stargazing LIVE 'Stargazing Challenge' film 1 – Scale Model of Solar System using fruit**

EXTENSION

Ask the children to draw a map or picture of the Earth in space to show what they understand about how the Earth moves, the other planets and anything else in our Solar System.

FURTHER ACTIVITIES

- The children can create a scale model of the Solar System using a loo roll and a selection of fruit – see Stargazing LIVE Planetary Activity Card number 3/9 at bbc.co.uk/stargazing under the How To Guides tab
- The children can use the Stargazing LIVE Star and Moon Guide (Space Stats and How Big is Space? pages) and other reference sources to research further Solar System facts and use the information to create a fact file

EARTH, SUN AND MOON ORBITS

🕒 1 HOUR

OBJECTIVES:

- To know how day and night are related to the spin of the Earth on its own axis
- To know that the Earth orbits the Sun once each year, and that the Moon takes approximately a month to orbit the Earth

CHILD FRIENDLY OUTCOME:

- To describe the movement of the Earth, Sun and Moon and how long these movements take

🎬 FILM CLIPS:

- Stargazing LIVE 'Stargazing Challenge' film 2 – Earth, Sun and Moon orbits

RESOURCES:

- Coloured chalk – playground chalk or normal chalk

INTRODUCTION

Ask the children in groups to discuss the movements of the Earth, Sun and Moon and to create a group diagram on large paper using arrows to show movement. (Make it clear that these do not have to be to scale.) Display the diagrams and ask the children to give feedback on each other's work to the whole class.

- ▶ Show Stargazing LIVE 'Stargazing Challenge' film 2 – Earth, Sun and Moon orbits

ACTIVITY

Explain to the children that they are going to work in groups to act out the orbits of the Earth and Moon around the Sun as they have seen in the video. Then each group will perform for the others.

In the playground give each group a space to work in and ask them to draw the Sun and the orbit of the Earth using the chalk. Ask three or four children to stand on the Sun bending and stretching and waving their arms to represent solar activity. Then ask two children to be the Earth facing each other and holding both hands. Ask the 'Earth children' to rotate slowly anticlockwise whilst also walking slowly anticlockwise around the Sun. Ask one child to be the Moon. Explain that the same side of the Moon always faces the Earth so they have to orbit the 'Earth' walking sideways so they always face towards it.

Ask each group to perform so that the Moon orbits the Earth whilst the Earth orbits the Sun.

- ! **Safety: Children must be instructed to walk slowly so as not to fall over when moving backwards**



TO ACCOMPANY FILM 2: EARTH, SUN AND MOON ORBITS

Ask the children why they need to move slowly. Do they know how long the Earth takes to rotate on its axis (24 hours)? Do they know how long the Earth takes to orbit the Sun (365¼ days) and the Moon to orbit the Earth (about a month)? Can they act out their performance at the correct speed – very, very slowly.

Note: There are several different ways of measuring the period of the Moon's orbit. 27.3 days is the sidereal month, the time it takes the Moon to get back to the same position against the background of stars. 29.5 days is the period of the phases of the Moon. The latter is longer because the Earth is moving through space as the Moon orbits. The National Curriculum for England states "approximately 28 days".

PLENARY

Ask groups to make corrections to their diagrams if necessary and to add information about how long each orbit takes.

FORMATIVE ASSESSMENT

Do the group diagrams show an accurate representation of the Earth and Moon orbits?

EXTENSION

Ask the children to make their own poster showing the orbits of the Earth and Moon labelled with the relevant time periods.

The children could video or photograph each others performances and make these into a presentation or web page.

FURTHER ACTIVITIES

- The children could use the Stargazing LIVE Star and Moon Guide (The Basics section) to research definitions of other objects in the night sky
- BBC Bitesize: Earth, Sun and Moon activity bbc.co.uk/schools/ks2bitesize/science/physical_processes/earth_sun_moon/play.shtml
- BBC Science Clips: Earth, Sun and Moon activity bbc.co.uk/schools/scienceclips/ages/9_10/earth_sun_moon.shtml

PHASES OF THE MOON

🕒 1 HOUR

OBJECTIVES:

- To know that the Moon takes approximately 28 days to orbit the Earth
- To observe the phases of the Moon

CHILD FRIENDLY OUTCOME:

- To investigate the phases of the Moon

🎬 FILM CLIPS:

- Stargazing LIVE 'Stargazing Challenge' film 3: Phases of the Moon

RESOURCES:

- Stool or swivel chair
- Bright light source – overhead projector, bright lamp or whiteboard projector with board covered with a dark cloth to prevent reflection
- White ball attached to a short stick – a polystyrene ball or ping-pong ball is ideal

WORKSHEETS:

- Phases of the Moon
- Moon Base

INTRODUCTION

Show Stargazing LIVE 'Stargazing Challenge' film 3: Phases of the Moon – just the section that shows the Moon's phases changing. Ask the children if they can explain what is happening to the Moon. Is it really changing shape or does it just appear to?

ACTIVITY

▶ Show the complete film (Stargazing LIVE 'Stargazing Challenge' film 3: Phases of the Moon)

Show the children how they can recreate the model of the phases of the Moon seen in the video using a bright light source, the Sun, and a white ball on a stick, the Moon. The person holding the Moon acts as the Earth. Ask the children one at a time to sit on the stool, hold the Moon in the light and rotate so they can see how the appearance of the Moon changes as it orbits the Earth. Encourage the children to move the Moon in a slow anticlockwise orbit. When they have done this activity the children can complete the **Phases of the Moon** worksheet.

Note: Remind children not to put the Moon directly in front of the light source as this creates a solar eclipse rather than a new moon. Similarly, at the opposite side of the orbit, remind them not to allow the Moon to pass through their head's shadow as this creates a lunar eclipse. Instead encourage children to hold the Moon higher than the top of their head as this will avoid eclipses altogether. Partial and full eclipses are visible several times a year at different places on Earth but they are not part of the regular lunar cycle.

! **Safety:** Remind the children never to look directly at bright light sources as this can damage their eyes



TO ACCOMPANY FILM 3: PHASES OF THE MOON

Ask children to consider what would be needed to live on the Moon. List the problems such as no oxygen, no water, no electricity, no food, etc on the board. Ask the children to suggest possible solutions such as solar power, a greenhouse for growing plants that would produce oxygen and food, etc. Ask the children to design a Moon base that would allow people to visit the Moon for a holiday or for research using the **Moon Base** worksheet.

PLENARY

▶ **Show Stargazing LIVE 'Stargazing Challenge' film 3: Phases of the Moon.**

Repeat the section showing the Moon's phases.

Ask the children to say when it is a Full Moon, Half Moon and New Moon. Ask the children to explain to each other what they have learnt.

FORMATIVE ASSESSMENT

Can the children explain why the Moon appears to change shape? Do they complete the **Phases of the Moon** worksheet correctly?

FURTHER ACTIVITIES

- Ask the children to complete a Moon Diary over four weeks to record the full cycle of the Moon
- Children can use the Phases of the Moon section within the Stargazing LIVE Star and Moon Guide to research more information bbc.co.uk/stargazing

THE SEASONS

🕒 1 HOUR

OBJECTIVES:

- To understand that the seasons are caused by the tilt of the Earth's axis
- To know that the Earth orbits the Sun once a year

CHILD FRIENDLY OUTCOME:

- To explain how the Earth's tilt causes warmer weather in the UK in summer

🎬 FILM CLIPS:

- BBC Learning Zone Class Clip 1592
- Stargazing LIVE 'Stargazing Challenge' film 4: The Seasons

RESOURCES:

- Globe on a stand
- Torches
- Small whiteboards

WORKSHEET:

- Summer Winter

INTRODUCTION

Ask the children what they know about the seasons. Are they the same everywhere on Earth?

Show a picture from the internet of Christmas in Australia on the beach. Then show the children a globe on a stand. Can anyone explain why it is tilted? (Because the Earth is tilted in space.)

- ▶ Show BBC Learning Zone Class Clip 1592 (The Earth's Orbit around The Sun)

ACTIVITY

Recap that the Northern Hemisphere is tilted towards the Sun in summer but away from the Sun in winter. Ask the children in pairs to try to think up any theories why this tilt would make it warmer in the UK in summer.

Note: It is a common misconception that it is warmer because the tilt makes us closer to the Sun in summer but in reality the distances are so great this makes no difference. (If being slightly closer to the Sun made it warmer then it would be warmer at the tops of mountains not cooler.)

Introduce the video that will explain why we get seasons.

- ▶ Stargazing LIVE 'Stargazing Challenge' film 4: The Seasons

Ask the children to work in pairs using a torch and a small whiteboard. Ask them to draw a small house in the centre of the whiteboard.



TO ACCOMPANY FILM 4: THE SEASONS

One child holds the whiteboard vertically; the other shines the torch at the board. The first child draws a circle round the light beam on the whiteboard. Next the whiteboard is tilted towards the horizontal. Ask the children to watch what happens to the size of the circle of light – it spreads out. Ask them to draw around the new shape. Talk with the children about what has happened to the amount of the Sun’s energy falling on the house – it is less when the whiteboard is tilted away because the light is more spread out – this is like winter. When the board is tilted towards the torch the light is more concentrated – like summer.

➔ **Ask the children to complete Summer Winter worksheet**

PLENARY

Choose children to hold the globe and a torch. Ask others to instruct them how to act out the orbit of the Earth with the torch acting as the Sun.

FORMATIVE ASSESSMENT

Can the children explain that in summer the tilt causes the Sun’s energy to be less spread out, so the UK is warmer?

EXTENSION

Ask the children to repeat the activity using squared paper attached to the whiteboard. Ask them to work out the area of the two patches of light by counting the number of squares inside the two lines drawn.

FURTHER ACTIVITIES

- Ask the children to look at the Stargazing LIVE Star and Moon Guide at the star maps for different times of year. Can the children explain that different constellations are visible at different times of year because the Earth is in a different position on its orbit around the Sun?

MAKING ROCKETS

🕒 1 HOUR

OBJECTIVES:

- To know that objects are pulled downwards because of the gravitational attraction between them and the Earth
- To identify the direction in which forces act

CHILD FRIENDLY OUTCOME:

- To draw a diagram of a rocket launch using arrows to show the size and direction of the forces

🎬 FILM CLIPS:

- BBC Learning Zone Class Clip 1589 (Images of the Earth, Sun and Moon)
- Stargazing LIVE 'Stargazing Challenge' film 5: Rockets

RESOURCES:

- 35mm film containers (available from educational suppliers) – the translucent ones which have a lid with a rim on the inside work best
- Effervescent tablets
- Paper for making fins and nose cones
- Sticky tape
- Glue sticks
- Sealed sandwich bag



TO ACCOMPANY FILM 5: ROCKETS

INTRODUCTION

- ▶ Show BBC Learning Zone Class Clip 1589, which includes footage of a rocket taking off

Ask the children to explain what is making the rocket go up (thrust) and which forces are trying to stop it (gravity and air resistance).

Draw a diagram of the rocket launch and ask the children to suggest how arrows might be used to show the forces. A smaller arrow to show gravity and air resistance pointing downwards and a larger one to show thrust pointing upwards. Explain that the thrust arrow must be larger at take-off because the rocket is speeding up.

ACTIVITY

▶ Show Stargazing LIVE 'Stargazing Challenge' film 5: Rockets

Show the children a film container and explain that to make it go up we need a force pushing downwards. Inside a sealed sandwich bag, demonstrate how an effervescent tablet mixed with water will react to produce bubbles of gas (Carbon Dioxide) – an irreversible change. As more gas is produced, the pressure increases and a pushing force on the inside of the bag can be seen as the bag swells up like a balloon.

Ask the children to explain how this makes the rocket take off. (Inside the container, the force increases until it is strong enough to pop off the lid. Pushing the lid and the water downwards causes the container to move upwards.)

! Safety: Make sure you and the children stand well back when you launch the rockets

Note: Further instructions for building the rockets are on Stargazing LIVE Planetary Activity Card 7/9 bbc.co.uk/stargazing.

Give the children containers to decorate with paper fins and a nose cone then take the class outside to launch their rockets.

PLENARY

Back in class ask the children to draw a diagram of their rocket launch using arrows to show the forces.

FORMATIVE ASSESSMENT

Can the children explain that the thrust pushes downwards to make the rocket go upwards?

Can they explain that the thrust must be greater than gravity to make the rocket take off?

Do they show the force arrows correctly in their diagrams?

EXTENSION

Challenge the children to predict then investigate how high the rockets go if they use different amounts of effervescent tablet from a quarter to two tablets, or different amounts of water.

FURTHER ACTIVITIES

- Some children could photograph or video the rocket launch and this could be used to create presentations, posters or a web page
- The children could use Stargazing LIVE Planetary Activity Card 9/9 to build a Hoop Atmosphere Glider at bbc.co.uk/stargazing under the How To Guides tab

TELESCOPES

🕒 1 HOUR

OBJECTIVES:

- To observe and explore how lenses can be used to create a magnified image of an object
- To use scientific knowledge and understanding to explain observations

CHILD FRIENDLY OUTCOME:

- To make a telescope and investigate how they work

🎬 FILM CLIPS:

- Stargazing LIVE 'Stargazing Challenge' film 6: Telescopes

RESOURCES:

- Marbles
- Transparent cylindrical glasses of water with teaspoons
- 2 magnifying glasses per group, different sizes – or other lenses
- A3 card or cardboard tubes
- Child friendly scissors

INTRODUCTION

Give each group of children some marbles, a teaspoon and a glass of water. Ask them to drop the marbles into the glass and observe closely. Ask them to describe what they see. What is making the marbles look larger? Can they explain that the water is acting like a magnifying glass? Ask them to look through the flat surface of the water. Why do the marbles not look larger now? Can they predict what they might see if the glass was not curved? The flat surface of the water is like a window, the curved side is like a magnifying glass.

ACTIVITY

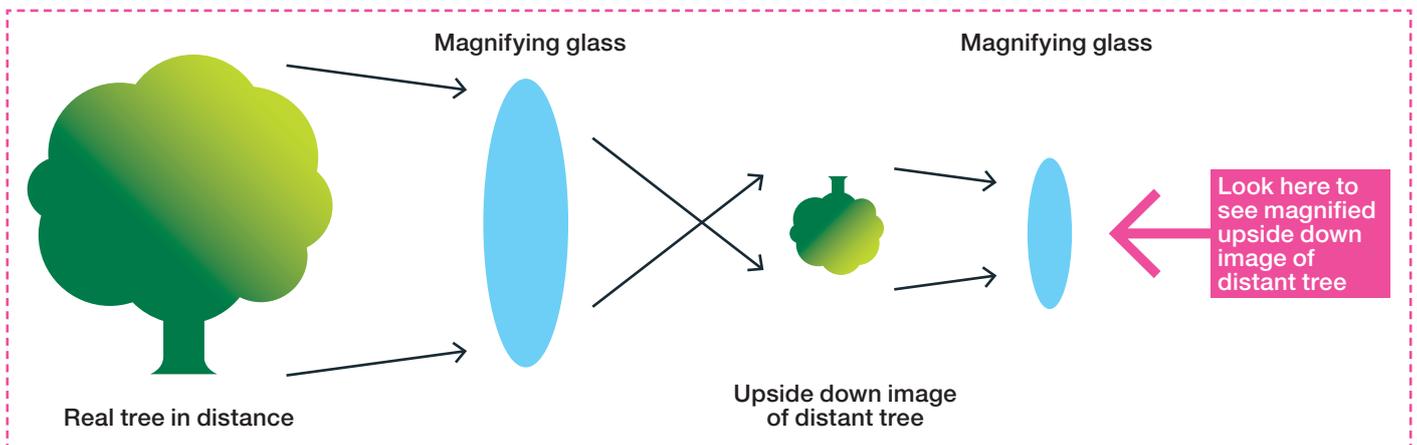
Ask the children to use magnifying glasses to look at familiar objects, pencils, text etc. Ask them to look at the shape of the lens. Can they explain that the magnifying glass only works because the lens is curved?

Ask the children to hold up the magnifying glasses and look through them at distant objects such as classroom displays. This works best if they hold the magnifying glass a short distance away from their eyes. Explain that if they hold the magnifying glass at the correct distance from their eye they should see a clear but upside down image of what they are looking at. Ask them to imagine what would happen if they used a second magnifying glass to look closely at this upside down image. Can the children suggest that using a magnifying glass should make the image appear larger?

- Stargazing LIVE 'Stargazing Challenge' film 6: Telescopes



TO ACCOMPANY FILM 6: TELESCOPES



In pairs or small groups give the children two magnifying glasses of different sizes and card to make a tube. Show them how to roll up the card to make a tube then remind them how to measure the distance between the two magnifying glasses by looking through them both to make a clear image of a piece of text – as demonstrated in the video.

Ask the children to mark the distance on their card tube then use scissors to cut a slot to hold each magnifying glass. Masking tape may be needed on the outside of the tube to hold the magnifying glasses in place.

! Safety: Scissors should be child friendly

Take the telescopes outside to look at the tops of trees and distant buildings.

PLENARY

Back in class show the children pictures of the Hubble Space Telescope. www.hubblesite.org/gallery/spacecraft/06/web_print

Then show some pictures taken by the telescope. www.hubblesite.org/gallery/album/solar_system

Explain to the children that this telescope can get better pictures because it is above the atmosphere so there is no air or pollution and the images are very clear.

EXTENSION

The children could take turns to borrow the telescopes to look at the Moon at home.

FURTHER ACTIVITIES

- Show the children some curved mirrors. Ask them to explain what they see
- Show the children how to use online telescopes such as...

www.faulkes-telescope.com

www.schoolsobservatory.org.uk

www.slooh.com

www.worldwidetelescope.org

www.telescope.org

PHASES OF THE MOON

NAME: _____

DATE: _____



NEW
MOON

WANING
CRESCENT

FIRST
QUARTER

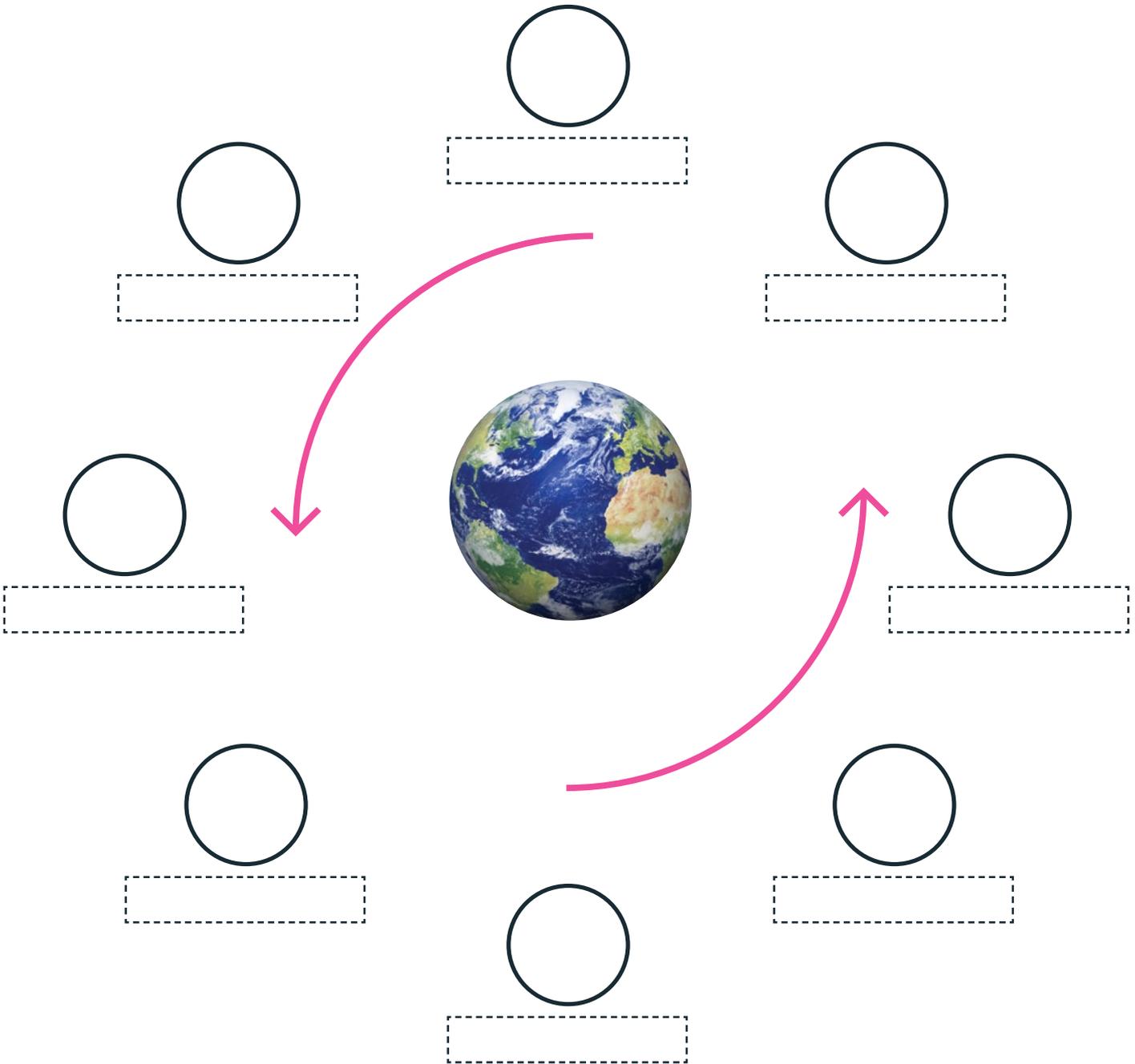
FULL
MOON

WANING
GIBBOUS

LAST
QUARTER

WANING
CRESCENT

THE SUN



WORKSHEET 2
MOON BASE

NAME: _____

DATE: _____

Design a spaceship or space pod that humans could live in on the Moon.

On the Moon there is less gravity, plenty of light, water hidden in the rocks but no air or food.

Start by writing how your design will meet these human needs.

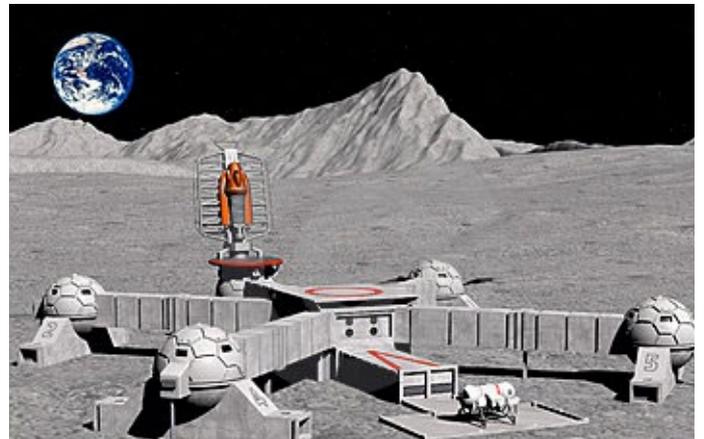
AIR:

WATER:

FOOD:

ELECTRICITY:

Now draw your Moon Base on the back of this worksheet. Use labels to show how things work.

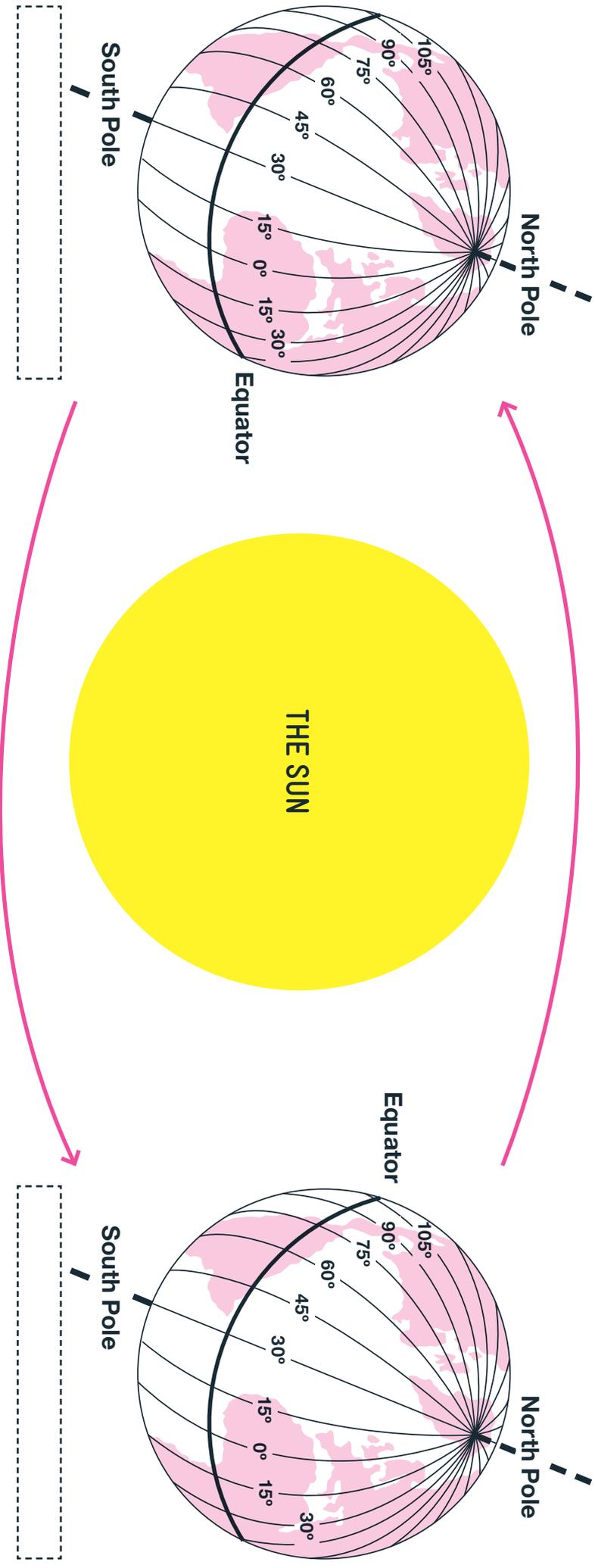


SUMMER WINTER

NAME: _____

DATE: _____

Label each position in the Earth's orbit as summer or winter.



Can you explain why the tilt of the Earth causes seasons?

bbc.co.uk/stargazing



© Published by BBC Learning 2012
Bridge House
MediaCityUK
Salford M50 2BH
Written by Jon Board
Design: red-stone.com

