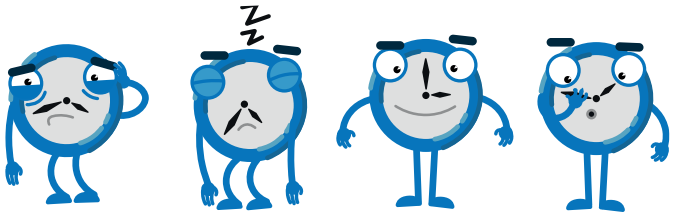
BBC TERRIFIC SCIENTIFIC

Teacher Resource



Time
Do I change when the clocks change?

Time

Terrific Scientific Campaign

Investigation: Time

Hello! Welcome to Time Investigation from the Terrific Scientific campaign!

At BBC Terrific Scientific, we think it is vital to develop science learning in primary schools across the UK. By taking part in this activity, you will be developing your class's scientific thinking and investigative skills.

At Key Stage 2 (Second Level), **children need to:**

- **Develop** investigative skills.
- **Understand** when it is important to control variables.
- **Predict, observe and record** results.
- **Draw conclusions** (which may generate new questions).
- **Understand** the need to repeat activities.
- **Record** what they see and not what they want to see.

We have incorporated these principles into this exciting activity. We've made it suitable for primary classrooms by using readily available equipment and suggesting opportunities for support and differentiation.

The BBC deems this activity safe if following some basic precautions. It is your responsibility as a School to carry out your own risk assessment and we recommend you consider the risks and mitigations we have described in this activity pack, as well as any risks which may be relevant to your specific class environment.

Important!

This investigation was originally designed to be carried out in the spring as the clocks move forward by one hour. It could easily be adapted to be delivered in the autumn when the clocks move back by one hour and the results compared.

As well as these key principles of working scientifically, we have made sure there are links to the science curriculum for each nation, as well as cross-curricular opportunities for further learning. We think these are just as important, as they help to explain the relevance of science and how it links to the world around us.

On our website you will find a supporting 'How to' film which shows teachers and teaching assistants how to set up and carry out the experiment. You will also find additional resources including a step-by-step lesson presentation, including an introductory film, which sets the investigation into context for your students.

We originally partnered with the University of Oxford for this investigation who used the data generated by the investigation to help further their scientific research; understanding how the clock change has an effect on sleep time and alertness. You can find the results from this investigation on our website.

Although data entry to the BBC map and university has now closed, you can still carry out the investigation and perhaps compare the results of the clock change in the spring and autumn.

We hope this inspires you and your students to get scientific!

The Terrific Scientific Team.

Related links:

Find out more about Terrific Scientific and our other investigations on – **bbc.co.uk/terrificscientific**

Contents

What will the children learn

Assessment indicators
This investigation will:

- **Develop** the scientific enquiry skill of Pattern Seeking by encouraging children to look for patterns in their results.
- **Encourage** children to draw valid conclusions from patterns and talk about possible cause and effect.
- **Help** children to recognise the limitations within their data.
- **Consolidate** the children's understanding of day and night.
- Use modelling to **support** the children's understanding of time zones.
- **Develop** observational skills and encourage children to draw simple conclusions from their observations using scientific language.

Children will show evidence of learning by:

- **Recording** data accurately.
- **Suggesting** improvements in the way that they gather their data.
- **Presenting** data in scatter graphs.
- **Recognising** patterns in their results as an individual / pair / class.
- **Using the data** to draw a reasoned conclusion about the pattern, linking cause and effect.

- **Recognising** the limitations of their data.
- **Creating** a model to demonstrate day and night.
- **Explaining** that the Earth rotates on its axis.
- **Demonstrating and explaining** that the Sun's apparent movement across the sky is not caused by the Sun moving, but by the rotation of the Earth.
- **Giving an example** of what might be happening in two different time zones at the same moment on Earth.

Curriculum points –

England, Scotland, Wales and Northern Ireland

Northern Ireland

NI 2007 page 90 How animal or plant behaviour is affected by seasonal change.
History: Page 89: 3.4 Technological changes and the impact of inventors and inventions over time. Science: Page 90: 3.4 Technological challenges of living in Space

Wales

Science 2008 Skills page 12 Make comparisons and identify describable trends or patterns in data and information. Use some prior knowledge to explain links between cause and effect when concluding.
Page 12 2. The need for a variety of foods and exercise for human good health.
Page 13a 1. The daily and annual movements of the Earth and their effect on day and year length.

Scotland

By investigating some body systems and potential problems which they may develop, I can make informed decisions to help me and maintain my health and well being SCN2-12a.
By observing and researching features of the solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it. SCN2-06a p264.

England

Year 6 Animals including humans p172: Recognise the impact of diet, exercise, drugs and lifestyle on the way that their bodies function.
Page 170 Y5 Earth& Space - Use the idea of the Earth's rotation to explain day and night and the apparent movement of the Sun across the sky.

Page 166 Working Scientifically Year 5/6:

i) Planning different types of science enquiries to answer questions.

ii) Identifying scientific evidence that has been used to support or refute ideas or arguments.

Important!

Looking straight at the Sun can cause damage to the eyes, so warn pupils not to look directly at it. Sunglasses offer no effective protection and telescopes or binoculars should never be used. Looking at the Sun is not needed for any of these activities.

Health and safety and control measures

The BBC deems this activity safe if following some basic precautions. It is your responsibility as a School to carry out your own risk assessment. We recommend you consider the risks and mitigations we have described in this activity pack, as well as any risks which may be relevant to your specific class environment.

The children will be required to insert a cocktail stick into their cardboard sundial. In order to do this safely they should place a blob of sticky-tack or plasticine behind the card. Place the card onto the table and then press the pointed end of the cocktail stick downwards through the card into the sticky-tack or plasticine, which can then be used to secure the stick in place.

Investigating Time

Introduction

Imagine that you are a pop star on a world tour, travelling nonstop between venues around the world. Your globe-trotting lifestyle would mean passing through lots of time zones and jet lag would be a real problem, messing up our body clock. You may become sleepy during the day and wide awake at night as your body struggles to work out a sensible routine.

Our bodies keep their own sense of time through a system called the body clock or circadian rhythms. One example of a circadian rhythm is your sleep/ wake cycle. Your body clock is controlled by a group of cells in part of your brain called the hypothalamus that respond to light and dark signals. At night,as the level of light decreases, our bodies respond by creating a hormone called melatonin, which makes us sleepy. In the mornings, with exposure to light, our brains send signals to raise body temperature and produce hormones like cortisol, which makes us wake up. Our body clock is like the conductor of an orchestra, keeping the different instruments together by beating time. If we did not have a central body clock, very soon our body systems would fall out of sync with each other, damaging our health and well-being.

Each year the clocks change in the Spring and in the Autumn; so even if we are not globe-trotting pop stars, we experience a change in our time. There is anecdotal evidence to suggest that the clock change affects our circadian rhythms. In 2017 BBC Terrific Scientific partnered with scientists at The University of Oxford to investigate whether the clock change caused any affect on children's sleep and alertness. The results of that study can be found on our website. Although that study has now closed, we invite you to try this investigation out in your own classroom.

Watch the film:

As an introduction to this topic we have produced a short film with Fleur East. Please show this to your class when you introduce the investigation: bbc.co.uk/programmes/p04sccwc

Remember:

Children must be ready to complete the investigation on the weekends before and after the clocks change.

The modern clock change is a relatively recent idea. In the years before the Victorian railways joined up the towns and villages across Great Britain, every town would operate on their own time. However, the invention of the national rail networks meant that it was more sensible to have one time throughout the country. So in 1880, all British clocks were set to Greenwich Mean Time (GMT). However, during the summer, Greenwich Mean Time was not in step with people's daily patterns. It was light by 3am and dark at 9pm, meaning that people missed out on precious daylight hours. So in 1907, a builder called William Willett came up with a solution. He noticed that in spring, the early evenings were dark. He decided that moving the clocks forwards in March would encourage people to get up earlier and make the most of the light. Many countries across the world have adopted daylight saving time in order to make the most of the light hours.

Sleep is studied by both Biological Scientists and Psychologists, who work to understand what happens when we are asleep and how important good quality sleep is for our daily lives. When people can't sleep well, they can become unable to concentrate or less healthy. So, studying sleep helps us to work out how to help people lead healthy lives. Psychological research often relies on questionnaire or self-report data. This is because the nature of what we are investigating is often about people's own experiences. Sleep diaries have been shown to be a valid and scalable way to measure sleep.

In this series of activities we begin by exploring the astronomy linked to time. Then the children investigate whether the clock change affects their sleep length and reaction times.

Preparation Activity

Exploring how shadow position can be used to tell the time.

Watch:

Stargazing LIVE have produced a number of films linked to the theme of Earth and Space. Please check the Terrific Scientific website for the links to these films.

Note:

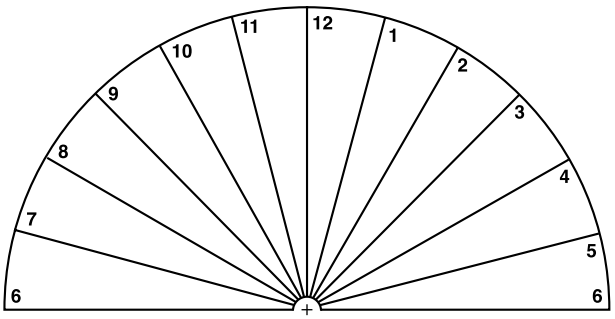
This optional activity helps to set the bigger picture and provide a deeper insight into the concept of timekeeping. Related activities can be found in the separate Additional Activities pack, available on our website.

Resources needed

- Internet connected display to show video (optional).
- White card printed with sundial templates (provided) OR protractors and plain white card.
- Cocktail sticks.
- A globe of the Earth

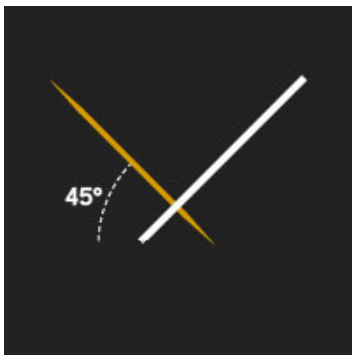
Charts, tables, paperwork needed

We have included this sundial template at the end of this document as a separate sheet so that you can easily print and cut out the sundials.



Important!

Instruct children to hold the cocktail stick in the centre between their thumb and forefinger before pressing downwards. Warn children that they should not place their hands on the pointed end of the stick to push downwards.



Instructions

A common misconception children have is the Sun moves across the Earth. However it is the Earth's rotation that changes the position in which we see the Sun at different times. The following models help children to see how the Earth's rotation causes the position of shadows, caused when sunlight is blocked, to move.

This activity should be done individually to ensure that children manipulate the model and see the changes clearly.

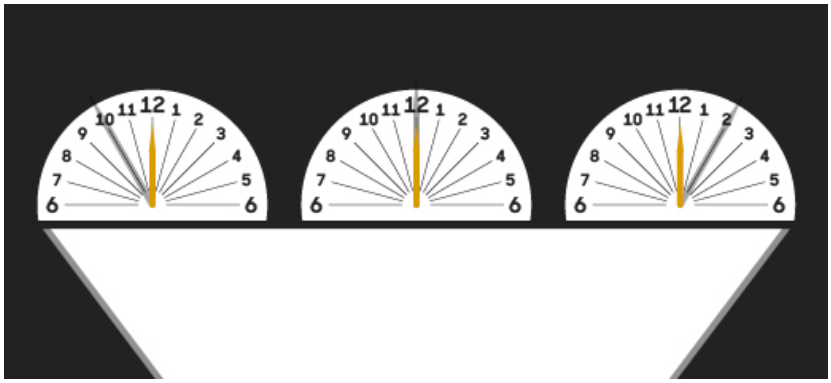
1. Cut out the sundial template. (Available at the end of this activity sheet).

2. The children should place a blob of sticky-tack underneath the template. Stick the sharp end of the cocktail stick through the cross in the centre. Instruct children to hold the cocktail stick in the centre between their thumb and forefinger before pressing downwards. Warn children that they should not place their hands on the pointed end of the stick to push downwards. The sundial base should then rest at an angle of approximately 45 degrees against the stick, which you can secure in place using sticky-tack. The children should place the sundial directly in front of them with the gnomon, or shadow-casting (cocktail) stick, pointing upwards.

3. Find out where the torch which represents the Sun needs to be for the sundial to say 12noon. Try making the sundial say 6am / 9am / 3pm / 6pm. **What do you notice about the position of the shadow over the day?**
4. Line up several sundials along a desk. Angle the torch towards the sundials. **Why do the Sundials all say different times?** The children should see that each shadow on the sundial is in a slightly different position, so they all tell a different time, even when lit from just one light source.

Duration:

These activities should take around 1 hour to complete.



Ask:

Check understanding: ask the children which is moving - the Sun or the Earth?

5. Now prepare your globe. Use sticky-tack to stick the sundial onto the northern hemisphere of the globe, with the 12 at the top. Line up the Sun so that it is casting a shadow to 12 noon. As you move the globe around, what happens to the shadow? (It should move to tell different times) This model should help the children to understand that it is the Earth's rotation that causes the passing of time on the sundial.

6. Now try adding another sundial to another part of the globe so that you can see the Sun shining on it too. You will see that the second sundial will tell a different time to the first, illustrating time zones, the idea that it is different times of day in different location on the Earth.

Main Activity

Do I change when the clocks change?

Over two weekends, the children will be asked to record the time they go to sleep and the time they wake up. In addition, they will be asked to test their reaction times with a simple test.

From this data, the children can then look for patterns to see if their sleep has been affected by the change of clocks, and if it has, is there a knock on effect on their reaction times?

You could easily adapt the material to investigate the clock change in the autumn when the clocks move back one hour to return to GMT, and compare results between the two.

Important:

Sleep and bedtimes can be a sensitive issue. It is important that the children recognise that we all have slightly different needs in term of the quantity of sleep. However, what is really important is the quality of our sleep, if we don't get enough sleep: it can affect our performance.

Equipment needed

- Sleep diaries (see separate document).
- 30 cm rulers.
- Reaction time conversion charts (provided).
- Reaction time tables.
- Karolinska sleepiness scale (provided).

Expected duration

This investigation takes place across two weekends either in March or October when the clocks change. Part of the activity will take place at home. Classroom time will vary depending on your approach, but the tests should take less time as children become used to the procedure.

Does the clock change affect the amount of sleep you get?

In order to gather the data we need to learn about the effect of the clock change, the timing of this investigation is very important. This part of this investigation takes place at home.

On the weekend before the clocks change and on the weekend of the clock change, using the supplied **sleep diary template**, children will need to record:

- The time when they switch off the light to sleep (Friday, Saturday, and Sunday Night).
- The time when they wake up (Saturday, Sunday and Monday morning).
- On a scale of 1 - 10 how easy it was to wake up.
- How many hours they slept for.

Some children may need support from home with telling the time or keeping a consistent record every day for a week.

Reassure the children that no one is judging their bedtime, as that is for each family to decide. Also reassure the children that it is OK to write the time they settled down to sleep, they don't need to record the moment their eyes shut!

In the classroom the children will need to work out what their normal week day sleep patterns are, this can be calculated from their usual bedtimes.

Ask the children to write down:

- The time they usually go to bed at on Mon/Tues/Wed/Thurs/Fri
- The time they usually wake up on Tues/Wed/Thurs/Fri

They can use this then:

- Calculate how much sleep they get Mon/Tues/Wed/Thurs night
- Work out how much the average amount of sleep they get (in minutes) on a weekday night.

Discuss:

How can they make their sleep diaries as reliable as possible?

Why should they be truthful about their bedtime?

What is useful / not useful data?

Important:

Sleep and bedtimes can be a sensitive issue. It is important that the children recognise that we all have slightly different needs in term of the quantity of sleep. However, what is really important is the quality of our sleep, if we don't get enough sleep: it can affect our performance.

Results
Analysing data - Sleep diary

1. Once the sleep diaries have been completed ask your children to:

- Fill in the column with the time converted to minutes
- Work out the average time in minutes they slept on the weekend without the clock change and record this in their diary.
- Work out the average time in minutes they slept before and after the clock change and record this on their diary

Some children might need support with these calculations.

2. Next, ask the children to look at their sleep diary and ask these questions:

- How many hours of sleep do you get each day?
- Is there any difference in the amount of sleep you got either before or after the clock change?
- Is there any difference in the amount of sleep you get on during the week and on the non-clock-change weekend?
- Is there any difference in the amount of sleep you got on a weekday and after the clock change?
- Is there any difference in the amount of sleep you got on both weekends?
- Do you think that the clock change had any effect on your sleep?

Ask the children to answer YES / NO / NOT SURE but then to underpin their answer with a reason using their data. They could create bar charts to show day of the week / amount of sleep.

3. Talk about how reliable their data was:

- Did they have any issues with collecting data over a week?
- What would you do differently another time?

4. The Scientists at Oxford University didn't know how the clock change affected the human body. So to find out they asked children from across the UK to take part in their investigation. What was the benefit of such a large sample size? What are the draw backs of a small sample size like one class?

Important!

It is important to make sure that children take into account the hour lost when the clocks change early in the morning on the Sunday. Effectively, 1am becomes 2am. They will in fact have one hour's less time to sleep on that night e.g. if they went to bed at 9pm and woke up at 8am they would have 10 hours sleep and not 11 hours as you might expect.

Discuss:

Why do scientists need as many people to do the survey as possible?

Does the clock change affect your alertness and reaction times?

On Friday and Monday, before and after both weekends of the study; the children will carry out two simple measurements in the morning and afternoon on each of those days. You may wish to conduct this test as part of a Maths lesson as it involves measuring, conversion and averages.

The first measurement uses the Karolinska Sleepiness Scale to assess their level of alertness. This is a simple 9 point scale, where 1 is extremely alert and 9 is extremely sleepy. The children simply choose a number on the scale that reflects their level of sleepiness and record it on their reaction table. This should be recorded **once** in the morning and once in the afternoon **before the reaction time test** on Friday (before the clocks change) and Monday (after the clocks change).

Discuss:

In order to fully understand the scale, the children could role-play different levels of alertness or sleepiness with 1 being extremely alert to 9 being extremely sleepy.

How might you feel if you are really tired?

How might you feel if you have just woken from a good night's sleep?

How might you feel at the end of a day after you had been running about?

Karolinska sleepiness scale

Degree of Sleepiness	Scale Rating
Extremely alert	1
Very alert	2
Alert	3
Rather alert	4
Neither alert nor sleepy	5
Some signs of sleepiness	6
Sleepy, but no difficulty remaining awake	7
Sleepy, some effort to keep alert	8
Extremely sleepy, fighting sleep	9

Ruler reaction time

Watch the film:
Watch the How to do the Time Investigation film on our website for a step by step guide.
bbc.co.uk/programmes/p04s224k

Ask:
Which variables do you need to keep the same?

Why?

The second measurement that the children will collect is their reaction time. This needs to be measured on the Friday morning and afternoon before the clock change, and on the Monday morning and afternoon after the clock change. Again, this needs to be recorded on their reaction table.

To work out the speed of their reaction the children need to follow this experiment procedure.

1. Children will work in pairs, sitting or standing directly across from each other. Partner one, will extend their writing arm out in front of their body. Make a fist with their hand, thumb side up. Point thumb and index finger forward, keeping them about 2 cm apart. They must use their index finger and thumb to catch the ruler immediately after it has been released by partner two.

   Partner two, holds the ruler between the outstretched index finger and thumb of their partner's writing hand. They must line the top of their thumb level with the zero centimetres line on the ruler. Without warning, they release the ruler, letting it fall between their partners thumb and index finger.

   During a scientific experiment it is very important to make sure that we keep all of the possible variables controlled and constant. Ask the children: **which variables do you need to keep the same? Why?** For example, they should always use their writing hand to catch the ruler. Always do the test with the same partner, who must always drop the ruler from the same height and they must always use the same ruler.

2. When they catch the ruler, they should note where the top of the thumb is to the nearest centimetre. The point that they catch the ruler will indicate the speed of their reaction. They should record the catch distance and the speed onto the reaction table, using the conversion chart to change the result from centimetres to milliseconds.

3. They should repeat the test 5 times and then average the results and record this.

Ask:

Ask the children why is it good to test your reaction times more than once?

Why is taking an average score more reliable than testing your reactions once?

Reaction time conversion table

We have provided a template for your children to use to capture their reaction times on our website.

Results
Analysing data - Reaction times

1. Ask the children to look at their individual reaction times comparing their results between **Friday** and **Monday**. Ask:

   - Do your reaction times increase, decrease or stay the same?
   - Is there a difference between your reaction times from both weekends?
   - Why do you think this pattern exists?
   - How do your reaction times relate to the amount of sleep you have had?
   - Are your reaction times linked in any way to your level of sleepiness?
   - Do you think it has anything to do with the clock change?

2. Ask the children to compare their results between mornings and afternoons and answer the same questions as in 1 above.

3. Then ask the children to compare their averages with a friend and ask:

   - Are there any similarities or differences in your data?
   - Can you see / describe a pattern emerging in your data?

Notes:

Scatter graphs are used to show the relationship between two sets of variables. By looking at the pattern of results you can see whether there is a link between variables. Where there is a link it is called **correlation.**

4. As a class, the children could plot scatter graphs for FRIDAY AM and MONDAY AM, comparing their Karolinska rating v Reaction times to explore the relationship between alertness and reaction time.
See the supplied Excel template on our website to help with this activity.

Look at the Friday morning graphs.

Is there a positive correlation between your level of alertness and your reaction time?

Can you create a comparative statement?

For example: 'the more alert, the faster the reaction.' Next ask the children to compare their Friday morning graph, with their Monday morning graph.

What do they notice?

Notes:

Our circadian rhythms have a postprandial slump between 12-2pm after a meal where may people feel slightly sluggish or drowsy.

Extension activity ideas

- How else could you investigate the affect that sleep has on your body?
- Can you create a device to measure one minute exactly?

The nature of data from a social science investigation...

It is also good to consider the sample size with children. Talk about the idea that a large sample size is a good way to look for patterns in the data. In the original investigation in 2017, the scientists at the University of Oxford were looking to see if the clock change affects children's sleep and so they needed responses from children all over the UK.

Working scientifically - pattern seeking

Both the sleep diary and the reaction tests create a myriad of opportunities for children to look for patterns in their data. They can do this on lots of levels - individually, as a class, and also by comparing their school sleep data with national data on the BBC online map.

The children are going to look for correlations (connections between data), which they are going to try and explain using simple scientific language. They should keep an open mind. As with all good science, we don't know the answer to our key question already; it was as much of a learning journey for the scientists at the University of Oxford as it is for the children in your classrooms. So the children should be prepared for any eventuality – we don't know if the clock change causes a change in children's sleep. There may be a causal relationship, there may not. The children should also take time to evaluate the reliability of their data, critiquing it, suggesting ways in which their data capture could be improved and be ready to think about reasons for any anomalous results.

Cross curricular ideas

History

- Research a history of Time.
- See the resource bbc.co.uk/education/clips/zwj2hyc
- Make a cartoon / storyboard of time through the ages.
- How did the Babylonians or the Egyptians tell the time?

English / History

Create a dramatic advert / sketch about the invention of standard time. Why might life be better? Also consider why people might not like a standard time and what you may need to say in order to convince them.

For many years, people worked out the time by looking at the position of the Sun overhead. Because every town was in a different place, every town had its own local time. For most of the time, this difference didn't matter until the arrival of the railways. People needed a reliable way of knowing what time the train would arrive or depart. So the Victorians got around the problem by abolishing local time. The Great Western Railway was the first to introduce a standard 'Railway Time' in 1840.

Maths / Geography

- Watch the video clip bbc.co.uk/education/clips/zrw2hyc and practise converting time to the 24 hour clock.
- Look at a time zone map. You can find many on the web, there is an interactive one here on the news website: bbc.co.uk/news/world-12849630

Maths / Geography (Continued)

If the time in the UK is 8am, what time will it be in Australia? India? Malaysia? Peru? Uruguay? Mali? Tanzania? Hint: when working out the time in those countries, don't count the time zone you are in! Why not make clocks to show the time in different places around the world?

Airlines publish flight times with the departure time from one country and then the arrival time of another country. Many journeys involve flying through at least one time zone. Work out the duration of the journeys, taking into account the time zones.

Geography

Make a comparison time line for a person in the UK and India. Draw or write what you would be doing at this time. Then research what a child in another country might be doing at that moment.

When it is 8am / UK	When it is 12pm / UK	When it is 4pm / UK	When it is 8pm / UK
It will be _____ in India	It will be _____ in India	It will be ____ in India	It will be _____ in India

Geography / Science

Make a sundial in the playground. You will need a compass for this, as in order to work, sundials need to face north. For more sundial activities see here:
https://www.britishscienceweek.org/app/uploads/2015/10/Primary-BSW-2017-Activity-Packv2.pdf

PHSE / Science / Speaking and listening

Research: How can I get better sleep? Keep a sleep diary of your normal sleep patterns using the Karolinska Sleep Scale. Then try out one of the ideas for sleep improvement on yourself for a week. Record your findings using the Karolinska Sleep Scale in a diary. Analyse your results. Produce a film advising people how to improve the quality of their sleep.

Music

Investigate lullabies - talk to your friends who have baby brothers and sisters. Which lullabies do they sing at home? Ask your families which songs they sang to you when you were little. Listen to Mary Poppins' Stay Awake' song. Why does this song make you feel so sleepy? Analyse - what is the perfect recipe for a song to make you truly sleepy? Write your own lullaby.

Art

Explore the dreamscapes of surrealist artist Marc Chagall - create your own dreamscape.

Science

Some animals are more active at night. They are nocturnal and sleep during the day. Research diurnal and nocturnal animals - how are nocturnal creatures adapted for being active at night? Why might it be good to be a nocturnal animal?

On the International Space Station the sun rises and sets 16 times each day, so how do astronauts maintain healthy circadian rhythms?

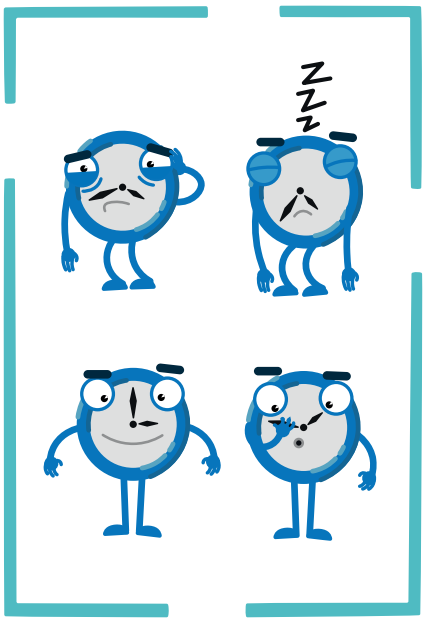
FAQs
Background information for teachers

How do sundials work?

Sundials are instruments for telling the time. The surface of a sundial has markings for each hour of daylight. As the Sun moves across the sky, another part of the sundial, called the gnomon casts a shadow on these markings. The position of the shadow shows what time it is.

The Sun is highest in the sky at midday and casts a short shadow.
In the afternoon, when the Sun is lower in the sky, the shadow is longer.
The movement of the shadow is caused by the Earth's rotation.

If you had a twenty four hour sundial, where would you put midnight?



Why do we have time zones?

(This is a concept for more able learners.)
As the Earth rotates on its axis, the Sun shines on only one part of the Earth at a time. While the Sun shines where you live, it's night-time somewhere else. It wouldn't make sense for everyone on planet Earth to be on the same time. Instead, countries all over the world are divided into different time zones. Time zones make it so that everyone has the same pattern of the Sun rising in the morning and setting at night. The Earth takes 24 hours to turn once on its axis. One full rotation of the Earth is 360 degrees. If you divide 360 degrees by 24 hours, the Earth has moved 15 degrees in one hour. In total there are 24 time zones covering the Earth, one every 15 degrees. (Time zones fall 7.5 degrees either side of a line of longitude).

Large countries, such as the U.S. and Russia, may be divided into three or more time zones, but most countries are small enough to fall in one zone. As time has gone on, things have changed. Time zones are irregular and affected by political, geographical and social changes. So in some parts of the world such as Market Reef, which belongs to both Sweden and Finland, each country is in a different time zone, so the small island falls in two time zones.

Can you find any other examples of places covered with two or more time zones?

What are lines of longitude?

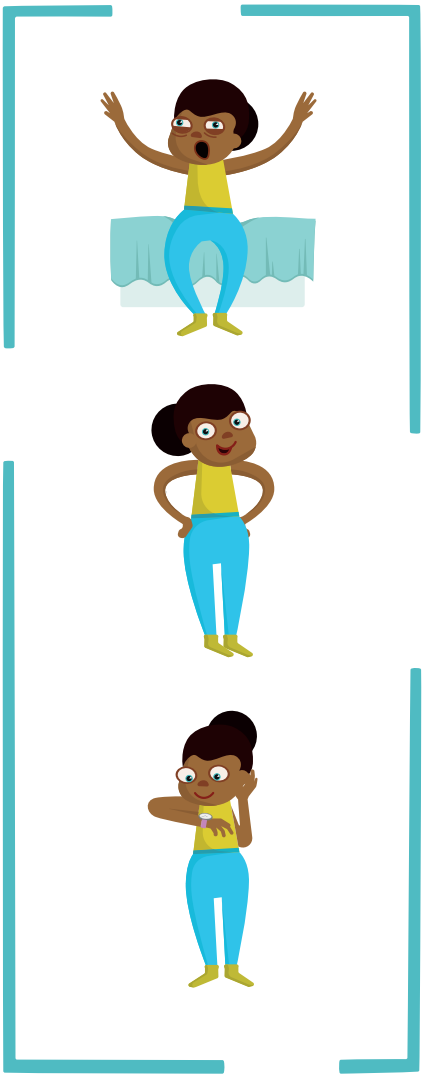
Have you ever looked at a globe or a map of the Earth and wondered what the vertical lines mean? They are lines of longitude. Longitude is the location of a place east or west of a north-south line called the prime meridian. There is one line of longitude every 15 degrees. Lines of longitude meet at the North and South Pole. The Prime Meridian (0 degrees) runs through Greenwich
in London.

Which other countries does the Prime Meridian pass through?

How do time zones work?

Time zones east of the Prime Meridian are ahead, for example Paris is one hour ahead of London. Time zones west of the Prime Meridian are behind, for example New York is four hours behind London. On the opposite side of the world is a place known as the International Dateline. The Eastern Hemisphere, to the left of the International Date Line, is always one day ahead of the Western Hemisphere. The International Dateline is not straight; it bends in order to keep whole countries within the same date. Find out which countries might have been in two different days if the international dateline was straight.

Can you find out which countries are permanently in daylight saving time?



What are circadian rhythms?

This is the scientific name for cycles that naturally occur in your body, one example of this is your sleep - wake cycle. Your body clock is controlled by a part of the brain called the Suprachiasmatic Nucleus (SCN) a group of cells in the hypothalamus that respond to light and dark signals. At night, as the level of light decreases, our bodies respond by creating a hormone called melatonin, which makes us sleepy. In the mornings, with exposure to light, the SCN sends signals to raise body temperature and produce hormones like cortisol, which makes us wake up.

The SCN is like the conductor of an orchestra, keeping the different instruments together by beating time. If we did not have a central body clock, very soon our body systems would fall out of sync with each other, damaging our health and wellbeing.

Why might lights at night, for example from a computer, muddle up your body clock?

Why is sleep good for us?

Sleep helps our bodies to grow and repair. It also allows our brain time to rest and develop so that in the daytime we can concentrate and learn. Everyone needs a different amount of sleep however, in general, most children, aged between six and twelve years old sleep for around 10 hours per night.

The main thing is that you feel awake and alert in the morning.
There are things you can try to help you get a good night's sleep:

- Make sure your room is cool, dark and quiet.
- Exercise during the day…But stop 3 hours before you are due to go to bed, so that your body can get ready for sleep.
- Avoid large meals before bedtime.
- Have a bedtime routine to signal to your body it is time for bed.

- Don’t drink caffeine in the afternoon or evening
- Try to go to bed the same time every night.
- Avoid watching TV an hour before bedtime.
- We all have worries from time to time. Make sure that you talk to a trusted friend or adult about your worries.

What happens when I am asleep?

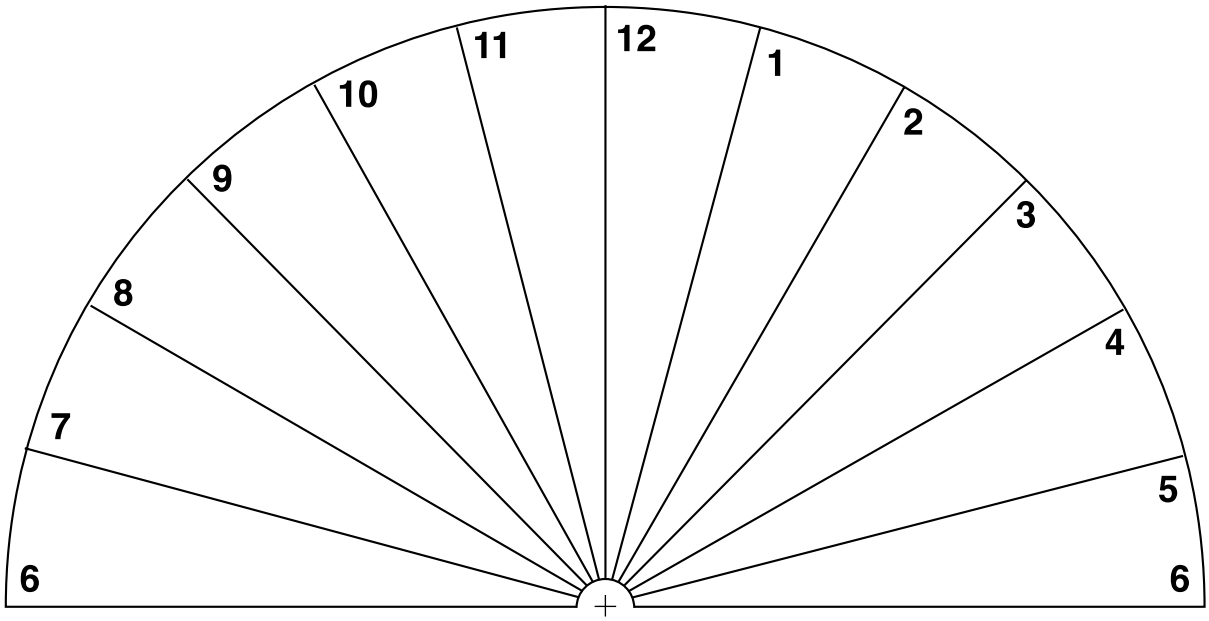
There are different stages of sleep. First of all you begin to drift off to sleep. You sleep lightly at first, so a noise might wake you. Then after a while you relax into a deeper sleep. Your heart slows down and your breathing is a little slower. Your body temperature drops a little too. Then you enter a phase called Slow Wave Sleep. You are really sound asleep now, your body totally relaxed.

Following on comes REM or rapid eye movement sleep. Your heart beats faster and your breathing is less regular. This is the part of sleep where dreams happen. Dreams are a way for your brain to make sense of the day, to work through some of your ideas. They may seem strange but they are a natural part of sleep. You will go through a sleep cycle of each stage a few times each night.

Glossary

Axis	The axis of the Earth is an imaginary line drawn through the North Pole and the South Pole.
Body Clock	The natural cyclical system in your body that controls your behaviour at particular times of the day or year, for example, what time you wake up or feel hungry.
Circadian Rhythms	Comes from the Latin ‘circa’ meaning ‘around’ and ‘diem’ meaning ‘day’ and is often referred to as our “body clock”.
Earth’s Rotation	When the Earth turns around its axis, it is called a rotation.
Gnomon	Shadow casting stick on a sundial.
Longitude	A distance measured in degrees east or west from an imaginary line (called the prime meridian) that goes from the North Pole to the South Pole and passes through Greenwich.
Shadow	A shadow is made when an object blocks light. The object must be opaque or translucent to make a shadow.
Sundial	Sundials are instruments for telling the time.
Time Zones	A region of the Earth where the same standard time is used.

Sundial Template



Sundial template to print separately and cut out.