

LESSON PLAN PACKAGE

HEATWAVES

Thank you for downloading this lesson plan package from the Royal Meteorological Society in collaboration with the Young People's Trust for the Environment. You are welcome to modify it by adding your own slides to the presentations, or deleting ones you don't need.

The lessons have been designed to support learners in Key Stage 2 with understanding more about heatwaves, the reasons why we are likely to face more of them in the future and some steps that schools can take to protect young people during these events. The lessons can be adapted to suit other age groups by modifying the information given in the linked notes.

The Royal Meteorological Society works to strengthen the scientific study of weather and climate and to raise awareness of these key scientific areas. If you are interested in meteorology (the study of weather and climate) you can become a member of the Society. Discover more at: <https://www.metlink.org/>

At the **Young People's Trust for the Environment**, we want to inspire young people to look after our world. Our website is a great starting point for finding out more. You can find lots more supporting information by visiting the 'Explore' section of <https://ypte.org.uk>

This package of lesson plans consists of 4 lessons:

- **Lesson 1: What are heatwaves?**
- **Lesson 2: Why are heatwaves dangerous?**
- **Lesson 3: How can schools prepare for a heatwave?**
- **Lesson 4: What is your school like during a heatwave and how could it be improved?**

LINKS TO NATIONAL CURRICULUM

Science (KS2)

- recognise that environments can change and that this can sometimes pose dangers to living things.

Geography (KS2)

- use fieldwork to observe, measure, record and present the human and physical features in the local area using a range of methods, including sketch maps, plans and graphs, and digital technologies.
- describe and understand key aspects of physical geography, including climate zones.

NOTES TO TEACHERS

- ★ These teaching notes and activities run alongside a PowerPoint presentation and all slides are referred to in the notes. The information can be adapted to suit different learners at different stages by adding/deleting slides on the presentation and varying the level of detail used from the teacher notes.
- ★ Activities given are suggestions only. The main purpose of these resources is to provide key information and visual aids for teachers to adapt to their needs.

GLOSSARY OF KEY TERMS (in alphabetical order)

Atmosphere - The layer of gases surrounding a planet or other celestial body.

Anticyclone - An **anticyclone** is a weather phenomenon defined as a large-scale circulation of winds around a central region of high atmospheric pressure, clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere as viewed from above (opposite to a cyclone).

Climate change - a large-scale, long-term shift in the planet's weather patterns and average temperatures. It can be because of natural or human causes.

Climate - the average of the weather conditions in an area over a long period of time.

Fossil fuel - a fuel (such as coal, oil, or natural gas) formed in the earth from plant or animal remains. Fossil fuels are non-renewable as they will run out one day.

Global warming - A change in the Earth's climate because of an increase in the amount of greenhouse gases in the atmosphere due to human activities.

Greenhouse effect - a warming of the Earth's surface and the air above it. It is caused by gases in the air that trap heat from the Earth. These heat-trapping gases are called greenhouse gases. The most abundant greenhouse gases are water vapour, carbon dioxide and methane.

Heatwave: An extended period of hotter weather than expected for an area at that particular time of year, sometimes accompanied by high humidity.

Humidity: The concentration of water vapour that is present in the air.

Gulf stream: A strong ocean current that brings warm water from the Gulf of Mexico into the Atlantic Ocean. This keeps the climate in Britain warmer than other countries at a similar latitude.

Meteorology: Science that relates to the atmosphere including the study of weather and the climate.

Weather - the daily state of the atmosphere in any given place (in regard to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness).

1. WHAT ARE HEATWAVES?

Learning Objectives:

- **Children will understand what is meant by the term heatwave (and will understand that different places have different heatwave thresholds).**
- **They will discuss the fact that climate change is happening and the effect this will have on the number of heatwaves we might have in the future.**

SUGGESTED STARTER ACTIVITY

Slide 2: Invite children to talk in their groups for a couple of minutes about what they think a 'heatwave' is. They should aim to sum up the term in a sentence: ***"We think it counts as a heatwave when..."***

Gather their responses to refer back to (you may like to assign a scribe to each group to record the answer on a sticky note or similar).

TEACHER NOTES FOR POWERPOINT PRESENTATION

Slide 3: KEY QUESTION: What counts as a heatwave?

For the weather to constitute a heatwave, it has to be unusually hot for a sustained period of time. A UK heatwave is actually defined by the Met Office as a period of at least three days when the temperature is higher than the usual regional temperature threshold (the maximum expected for that area). If Summer temperatures are already usually quite high in a place, it has to get even hotter to count as a heatwave.

Slide 4: What temperature (in degrees Celsius) do you think counts as an unusually hot summer day in your region? - We will find out more about this later - so keep your answers!

If you are based in the Scottish Highlands, the average summer temperature where you live is lower than a region in the South of the UK. Hilly areas are usually cooler than flatter, lower lying regions. The closer a country is to the equator, the warmer its average climate and the hotter it is expected to be there.

In 2022, India and Pakistan experienced a heatwave that resulted in the hottest March since 1901. In India, a heatwave is declared when the temperature of a weather station reaches at least 30°C in a hilly area, or at least 40°C in the low lying plains. If a place typically already reaches 40°C, then a temperature of 5 or 6°C more than usual counts as a heatwave. Allow children to revise their own heatwave temperature predictions in the light of this information!

Slide 5: What causes heatwaves?

Heatwaves are most common in the summer when the weather is calm, clear and settled.

We associate these conditions with large anticyclones. In an anticyclone, the air is sinking and cloud is less likely to form, so we get clear skies and warm summer weather.

Slide 6: What is the difference between weather and climate?

Can anyone in class make a suggestion?

Climate is different to weather. Weather describes the day-to-day conditions in a particular place and it can change very quickly - one day it can be dry and sunny and the next day it may rain. When you go outside, or look out of the window and see it is sunny, or rainy, windy or stormy, this is the weather. Climate describes the average weather conditions in an entire region for a very long time – usually 30 years. This means climate is the weather we expect – so if I asked you what you expected the weather to be like on a day in July next year, you might say ‘warm and sunny’ because that is what it is like most often, whereas in reality it could be cool, cloudy, rainy or hot.

The UK has a ‘temperate’ climate. This means that we don’t *usually* experience extremes of heat, cold, rain or drought.

Slide 7: What is happening to the Earth’s climate?

The Earth’s climate is definitely changing - it is heating up. There have been peaks and troughs in temperature over the years, but there is now a steady and unremitting trend in the records which show that the Earth has warmed by an average of 1°C since the 1850s. This might not sound like very much, but it has very big implications for the people and animals on our planet. Rising temperatures don’t just mean we’ll get nicer weather. As the climate is changing, our weather is becoming more extreme and unpredictable. Why is this happening so fast now?

Slide 8: Fossil Fuels

Coal, oil and natural gas are known as fossil fuels because they were created millions of years ago from fossilised remains of organic material such as plants and animals. Over hundreds of millions of years, heat and pressure turned these remains into the coal, oil and gas that we use today. Humans have been using

fossil fuels for thousands of years (there is evidence that coal was being burned in China before 1,000BC) but we have become increasingly dependent on them since the Industrial Revolution, which began in Britain in the 1700s.

Fossil fuels can be burned in power stations to heat water and create steam, which in turn is used to generate the electricity that we use every day in our homes, schools and businesses. For more information, watch <https://ypte.org.uk/videos/how-is-electricity-made>. Industrialised countries burn huge amounts of fossil fuels in power stations as well as using them for heating and turning oil into petrol and diesel to power vehicles.

Slide 9: Unfortunately, when fossil fuels are burned, they release gases (such as carbon dioxide, sulphur dioxide, methane and nitrous oxide) into the atmosphere as waste products. When carbon dioxide and other ‘greenhouse gases’ (like methane and nitrous oxide) are released into the atmosphere, they

then act as an invisible blanket, trapping heat which is rising up from the Earth's surface and warming the Earth - this is called the greenhouse effect.

The greater the amount of fossil fuels burned, the greater the concentration of greenhouse gases in the atmosphere becomes and the more heat is trapped. Records show that global temperatures have been rising more rapidly since the time we started burning fossil fuels in large quantities.

A more detailed explanation of the greenhouse effect can be found on YPTE's video which can be downloaded using this link:

<http://yppte.org.uk/videos/the-greenhouse-effect>

Slide 10: KEY QUESTION: HOW IS CLIMATE CHANGE AFFECTING HEATWAVES?

The climate is warming up so much that the Met Office has had to change its definition of what counts as a heatwave in the UK. Remember - a heatwave means weather that is *unusually* hot. If hotter days become common, this means the temperature that counts as a heatwave is higher.

Here you can see three maps of the UK, together with a key, showing what counts as a heatwave in each area. The geographical differences (e.g. between Scotland and the South of England) show the difference in climate across the UK. These temperatures were calculated based on records for the daily maximum temperature in the middle of summer (15th July). On the left is the map from 1961-1990. The temperatures had to be raised as the average got hotter. The middle map shows the heatwave thresholds from 1991-2020. The new map, on the right, shows updated heatwave temperatures from 2022.

What do you notice about the threshold temperature for defining a heatwave now, compared to 1961?

Slide 11: Do you think that the heatwave threshold should be the same all over the UK?

Have a look at the UK heatwave threshold map again. Using an atlas, locate your school on the map. (You can use activity sheet 1 for this, if helpful). Label Edinburgh and London. What do you notice about the differences in the heatwave thresholds for these areas? As we have seen, heatwaves are declared when the temperature rises to several degrees higher than is typical for an area. Do you think that is a useful definition?

At the moment, a person who travels around the UK a lot may find that they are said to be experiencing a heatwave in one place and not in another, even if they travel to a hotter place! For example, if someone got on the train in Manchester on a sunny day measuring 26°C, they would be leaving a 'heatwave'. They might travel into central London where it was also 26°C. The temperature hasn't cooled at all - but the person is no longer technically in a 'heatwave' as temperatures have to reach 28°C there before a heatwave is declared!

Should there be one temperature that means it is a heatwave? How would you decide what that was? Are people who live in hotter places more used to the heat, or do you think everyone struggles to cope at a similar level of heat? If you had just one heatwave threshold, would it apply to all countries.

(Remember, in some parts of India, a heatwave is declared at 30°C and in others, not till 46°C - a massive 16°C difference!)

Slide 12: Heatwaves are becoming more likely in the UK

When the climate warms, all weather types can still occur, but extremely cold weather happens less frequently and extremely warm weather happens more frequently.

In the summer of 2022, some parts of the UK saw temperatures reach over 40°C for the first time in recorded history. The highest temperature recorded was 40.3°C in Coningsby, Lincolnshire. This was a huge 1.6°C above the previous highest recorded temperature for the UK.

Heatwaves are considered 'extreme' weather events, but a study in 2018 showed that the UK is now 30 times more likely to experience a heatwave than in the years before the Industrial Revolution, due to the increase of carbon dioxide in the atmosphere. Seven of the ten hottest UK temperatures recorded have happened in the years since 2003. If CO₂ emissions continue to rise, we could expect the UK to experience a heatwave around every other year by 2050.

Slide 13 : ACTIVITY: Find out how temperatures are predicted to change in your area based on a global temperature rise.

You might like to carry this activity out now - or you can do it at the end of the slideshow.

Provide children with a copy of Activity worksheet 1. You may like to print this in greyscale and at a smaller scale to reduce waste (but ensure that the map is still a clear read once photocopied). Use a map to locate the county that your school is in, then check the scale to see what the temperature threshold is for a heatwave. How does this compare to your prediction earlier (slide 4)?

Next, visit the BBC climate calculator at:

<https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138>

You could call this up on the whiteboard or ask pupils to explore in pairs or groups. Type in your school (or home) postcode and find out what the hottest day was locally in the 30 years up to 2019. You can also find out what the hottest summer's day is predicted to be with an overall global temperature rise of 2°C and 4°C above pre-Industrial temperatures. Fill these in on your sheet.

Extension: How much is your hottest summer temperature predicted to warm with 2°C global warming? Is that more or less than 2°C (you will need to

explain the fact that the predicted 2°C rise is a global and annual average, so the warming will be more in some places than others, and at some times of year than others).

How much is your summer temperature predicted to warm with 4°C global warming? Is that more or less than 4°C?

Try entering different locations around the UK into the search bar – which locations will see greater/ smaller changes?

Slide 14: 2022 Summer temperatures in the UK linked to climate change

Watch this short BBC video explaining that the hot days seen in the UK during Summer 2022 have been proven to be linked to climate change. Link, if required: <https://www.youtube.com/watch?v=QndWnjvETwk>

Climate change is going to lead to more extreme weather around the world. Although it does mean that the UK will expect to have more hot days and fewer cold days, it will also bring weather events such as flooding and intense storms to many parts of the world. There is a linked quiz for children to complete after watching the video. You may like to give out the questions before watching, or watch the clip twice, giving out the questions the second time (**Quiz activity sheets**).

Vocab check:

Unprecedented: Never done or known before

SUGGESTED FOLLOW UP ACTIVITIES

Activity worksheet 1: Find out how temperatures are predicted to change in your area based on a global temperature rise.

QUIZ: - watch the BBC video and answer the questions on the quiz sheets provided. <https://www.youtube.com/watch?v=QndWnjvETwk>

2. WHY ARE HEATWAVES DANGEROUS?

Learning Objectives:

- **Children will recognise that heatwaves can be dangerous for people, animals and the planet.**
- **They will understand why some geographical locations experience higher temperatures than others.**

SUGGESTED STARTER ACTIVITY

Identify children's understanding of the dangers of heatwaves.

Slide 16: KEY QUESTION: WHY ARE HEATWAVES DANGEROUS?

Ask children to work in pairs and discuss some reasons that they think heatwaves might be dangerous. They can include factors that cause danger to people, animals, or the planet. Share a few ideas.

Some things that children **may** come up with might include:

- Increased risk of drought and wildfires
- Negative impact on crops, farm animals, wildlife, water life
- Changes to what we eat (due to heat and access to food if crops fail)
- Changes to activities we are able to do (eg cancelled sports fixtures)
- People getting into trouble swimming in lakes and rivers, or beaches getting too full
- Changes to public transport (eg. trains cant run if the rails buckle, roads can melt)
- Dogs can't walk on hot tarmac
- People may suffer from heatstroke deaths, or sunburn

Slide 17: Heatwaves can lead to ill-health and even death

The hot weather that we experience during a heatwave can lead to serious health issues for people (and animals).

Going outside on a sunny day can lead to sunburn, which can be painful and can even lead to skin cancer. However, it is actually heatstroke that can pose a greater risk to health during a heatwave. Normally, we sweat to keep cool. During especially hot weather, our bodies may not be able to keep cool enough by sweating. This means our body temperature rises, which can lead to headaches, dizziness, and, in extreme cases, even death.

Dehydration - the loss of water from our bodies - is another risk of heatwaves. It can cause tiredness and problems with breathing or heart rate. People who are elderly or already ill are especially vulnerable.

Slide 18: A risk of drowning in cold water

As the weather warms up, people are more likely to jump into areas of water

to cool off. Unfortunately, this sometimes leads to tragic cases of drowning. The big temperature difference between the warm weather and the cold water can lead to cold water shock. This increases a person's heart rate and causes them to gasp for breath, making it more likely that they will inhale water. During the hot summer of 2022, the Royal Life Saving Society of the UK recorded 50 deaths caused by drowning between June and mid August. Many of these were teenagers.

Slide 19: A rise in air pollution

High temperatures can make air pollution much worse, because the air tends to get trapped in one place, instead of being moved around by a breeze. Sunlight and high temperatures can also cause chemical reactions in some pollutants, making air quality worse. People with asthma and other lung conditions are more likely to be badly affected. In the Summer of 2003, it is thought that as many as a third of the 2,000 UK deaths caused by the heatwave were due to air pollution.

Slide 20: Moorland and forest fires

Heatwaves sometimes lead to lower levels of rainfall. Very dry conditions mean that moorland and forest fires are more likely to break out.

In 2018, a wildfire on Saddleworth Moor in Greater Manchester blazed for more than three weeks, due to the hot, dry weather conditions. The fire started on June 24th (after reports of people starting a bonfire near Stalybridge) and raged until the middle of July. At its peak, the fire covered an area of seven square miles and a hundred soldiers were drafted in to help firefighters.

People are more likely to be outside having barbeques during hot weather, which can lead to sparks setting dry grass and vegetation alight. Despite a ban on barbeques on Saddleworth Moor being approved by Oldham Council after the 2018 wildfire, another large fire started on the same moorland in 2020.

Wildfires also harm layers of topsoil needed to grow healthy crops, and the ash that travels into rivers damages water quality.

Slide 21: Low water levels in rivers and reservoirs

Low rainfall and high temperatures mean that rivers, ponds, lakes and reservoirs can start to dry up. This can be a disaster for wildlife. Water supplies may also become too low for farmers to water their fields and can lead to drinking water scarcity. It can be tempting to fill a paddling pool during hot weather, but as heatwaves are likely to increase, so will hosepipe bans and other water-saving measures designed to make sure we all still have enough to drink.

Slide 22: Weather Warnings

When there is a risk of extremely hot temperatures, the Met Office issues Extreme Heat Warnings as part of the weather forecast so that people can be prepared, take precautions, and keep an eye out for vulnerable people. There are different levels of heatwave warning (you can make the link to traffic light

signals to help children remember):

Green is a level one warning and the lowest level - at this time, people should be carrying out usual summer safety precautions.

Yellow is triggered when the risk of heatwave threshold temperatures being reached is 60% or above in one or more regions over 2 consecutive days. It allows people to be alert and ready to take action if the situation worsens.

Amber means that there's a 90% chance of heatwave temperatures in one or more regions for at least 2 days. At this level of alert, there is a need to take care of vulnerable people.

Red is the highest alert. This is when a National Emergency is declared because the heatwave is at risk of affecting more than just vulnerable people - even fit and healthy people could become ill, or die.

With the risk of heatwaves increasing, the UK Health Security Agency has worked together with the Met Office to create a Heatwave Plan. This was issued by the government in 2014 to help advise on safety procedures. There is a special plan for teachers, to help protect people in schools.

Slide 23: Why do some geographical areas get hotter during a heatwave than others?

We have heard that hilly regions are generally cooler than low lying areas. This is because temperatures tend to be cooler at greater altitudes (heights) above sea level. Temperatures inland are also generally higher than the coast during the summer and warmer during the winter. This is because land heats up and cools down again more quickly than the sea.

Ask pupils if they know any hilly or mountainous regions of the UK (such as the Pennines) and support them to locate these using an Atlas. What might we expect to notice about the temperatures in these areas? Look at some of the coastal regions of the UK. Do you think we would expect the South coast or the North coast to be warmer?

Slide 24: Which parts of the UK were most affected by the heatwave in July 2022 and why?

Look at the map of the July 2022 heatwave warning produced by the Met Office. Using an atlas and working in pairs or groups as appropriate, discuss which parts of the UK are in the red, amber and yellow areas together with reasons for this.

Suggested answers:

Good answers could say that the red warning includes the cities of London, Manchester and York and that the amber warning covers a much greater area.

Better answers could mention England, Wales and southern Scotland and will give some additional place names, including places in the amber area (such as Cardiff, Bristol, Newcastle, or Plymouth - any place names in the amber area would suffice).

Best answers could mention the effect of the Pennines (which are relatively

high, and so Leeds and Sheffield aren't in the red zone) and the effect of the sea, which means the hottest places are away from the coast.

Slide 25: You might like to watch this **fictitious** weather forecast for the year 2050 based on possible future heatwaves. Make sure pupils understand that this is not a real broadcast! You can just click play on the slide, or visit <https://www.youtube.com/watch?v=l-o4IXrS8do>

2050 might feel like a fairly distant time to the children. Ask them to calculate how old they will be in 2050.

How does that compare to the age of their parents now? You might like to share your own age now to help them imagine this future age!

Students should notice that the temperatures in the 2050 forecast are warmer even than the 2022 heatwave. Obviously care needs to be taken around children's anxiety levels - this is a *possible* weather forecast and we are learning about this to help us all take action to try to avoid the worst effects and to prepare for them.

Slide 26: Group discussion - which of the dangers above do you think might pose a risk for people in schools?

Whilst it might be a good idea to warn pupils about the dangers of jumping into cold water, or having barbeques on dry days, the main issues affecting you in school come from the risk of overheating. Are there particular activities that might be high risk during a heatwave?

SUGGESTED FOLLOW UP ACTIVITIES

Further mapwork

Consolidate understanding by providing a list of locations (these could be in the UK or elsewhere) that include hilly, low-lying and coastal areas. Ask children to locate these places and sort them by which they think would be the warmest and coolest during a heatwave, given reasons.

Warning: heatwave!

Make explanation texts, booklets or visual aids to alert people to the dangers of heatwaves. Focus on different audiences such as: young children, those who care for the elderly, people planning to go on a summer barbeque picnic or swimmers. (We will focus on dangers specific to schools in the next two lessons).

3. HOW CAN SCHOOLS PREPARE FOR A HEATWAVE?

Learning Objectives:

- Children will understand that many countries have plans in place to minimise harm to pupils in schools during a heatwave.
- Children will learn about behaviour changes that can reduce risk during a heatwave.
- They will understand ways that school building use can be adapted during a heatwave.

SUGGESTED STARTER ACTIVITY

Slide 28: Group discussion: Talk about times when you have experienced extremely hot weather.

Working in groups, ask children to think about times when they have experienced hot weather. This may be in the UK, or abroad on holiday. You may live in a region that was affected by the heatwaves during summer 2022. What measures did people take to try to keep cool during those hot spells? How did people feel? Were they able to sleep and play as normal? Gather ideas about things that people have done to keep cool, such as sitting in the shade, using a fan, or cooling off in a paddling pool. How many of those things are easy to do in school?

TEACHER NOTES FOR POWERPOINT PRESENTATION

Slide 29: Extreme heat often affects our ability to concentrate well.

Our bodies need to use more water to sweat to keep us cool. It's vital we drink enough to replenish this or we risk becoming seriously dehydrated. Your blood is around 93% water and your brain is around 73% water, so it's easy to see that having too little water in your body can affect you a lot. It's thought that a reduction of just 2 to 3% in necessary hydration levels can reduce your concentration and reaction times by up to 20%. In fact, a Loughborough University study found that dehydrated drivers made the same number of mistakes as drivers who'd had a couple of alcoholic drinks.

Slide 30: How can schools best prepare for a heatwave?

Given that we know how dangerous hot weather can be for people's health and their concentration levels at school, what steps do you think could be taken to protect children (and teachers)? Think, pair, share a few ideas. The following slides are ideas that have been suggested by the UK government and the governments of other countries to help keep people safe.

Slide 31: Know the signs of heat related illness

Being exposed to high temperatures can cause illness and this can be worse in children as they don't sweat as much as adults, and often forget to drink enough water. Running around during a heatwave (such as at playtime) can

make symptoms worse.

Heat stress is often the first sign that something is wrong. A person with heat stress may be unusually grumpy and irritable. This will get worse with physical activity and can lead to heat exhaustion or heatstroke.

Heat exhaustion can include symptoms such as headache, dizziness and nausea or even vomiting. A person with heatstroke can have cold, clammy skin, even though it is hot. They may become confused.

Heatstroke, as we have seen in Lesson 1, can be serious. It can develop from heat stress or heat exhaustion, but it can also develop suddenly. Heatstroke is when a person can no longer regulate their body temperature (eg. by sweating). It can lead to a high temperature (40°C or higher is a major sign of heat stroke) and red, hot skin with sweating that suddenly stops. A person with heatstroke needs help to cool down slowly as they can develop shallow breathing, confusion and even seizures or a loss of consciousness.

Slide 32: Wear suitable clothing, including a sun hat - and apply sun cream. Guidance on what to wear forms part of many school heatwave plans. The French government suggests modifying the school uniform if necessary (for example wearing shorts instead of trousers). The UK government advises that children wear 'loose, light-coloured clothing' when playing outside, but it doesn't specify what to wear indoors. Both the French and UK governments suggest encouraging children to wear a sun hat, sunglasses and sun cream.

Do you know if your school has a sun-safe policy like this?

Slide 33: Try to stay in the shade when playing outside

During a heatwave, it's important to stay in the shade as much as possible. The UK Heatwave Plan Suggests that children playing outside should be encouraged to stay in the shade "as much as possible". However, many schools don't actually have access to shaded places outside for children to play. You might be lucky and have lots of trees in your school grounds, or perhaps you have some covered outdoor areas to play in. Typically, many school playgrounds are uncovered and they can get very sunny indeed on a hot day.

Slide 34: Avoid high energy activities during a heatwave

The UK Heatwave Plan suggests that vigorous activity such as sports should be avoided outside once temperatures reach 30°C. The French government also suggests limiting outdoor activities such as walks and school trips. What do you think about this idea? Is it best to avoid outdoor activities, or is the summer a great time to be outdoors?

Slide 35: Encourage people to drink plenty of water and to wet their skin

Since dehydration is such a serious problem and can really affect concentration and learning, most schools already have a policy in place to make sure that children have enough to drink during hot weather. The UK Heatwave Plan says that schools need to provide plenty of water and

encourage pupils to drink more than usual during hot weather. Perhaps you have water fountains at your school, or you are encouraged to bring in a water bottle. In France, children are also encouraged to wet their skin to help them cool down. Do you think this would work at your school? Could you foresee any problems with this idea?

Slide 36: Be especially aware of children who have health conditions such as asthma.

Some health conditions can make people more susceptible to heatwaves. Children with asthma may need to use their inhaler more frequently if air quality gets bad. If there are any young people (or teachers) with asthma in your class, maybe they would be willing to talk about how extremes of weather affect them. It's important for adults working in schools to know which children might need extra supervision during a heatwave so that they can check in with them.

Slide 37: Turn off electric lights and other appliances

Electric lights generate quite a lot of heat and so do other appliances such as projectors and computers - even when they are set to standby. During a heatwave, it's important to reduce every bit of unnecessary heat, so the UK Heatwave Plan suggests making sure that all lights and appliances are switched off.

Slide 38: Use an electric fan to keep air moving

A fan can keep you cooler during hot weather - but only up to a certain temperature. After that, it no longer cools the air, instead pushing hot air round the room. In fact, using a fan at very high temperatures can actually increase dehydration. It can sometimes help to put bottles of frozen water in front of the fan - this could be something that you experiment with in a science lesson on a hot day! The UK Heatwave plan suggests that an oscillating fan (an electric fan that can move from side to side, up and down, or both) can be used in classrooms up to 35°C. That's a really warm temperature - you might want to remember it for later...

Slide 39: Consider changing the timings of the school day to avoid hot weather.

One of the other recommendations in many heatwave plans is to change the timings of the school day, so that lessons and break times aren't taking place during the hottest part of the day. Some UK schools closed in the afternoons during the heatwave in 2022. Many schools changed their playtimes if it was too hot outside and they didn't have enough shaded places for all the children to play. If the UK is going to see more and more heatwaves, it might become common for schools to open and close earlier.

Slide 40: HOW CAN USE OF SCHOOL BUILDINGS BE ADAPTED TO HELP DEAL WITH EXTREME HEAT?

In countries that experience a lot of hot weather, many buildings have features that help them to cope, such as sun shades or air conditioning. Other countries have to change the way that they use buildings during hot weather, such as by limiting the use of very hot rooms, or opening windows to increase airflow.

Sometimes, schools close altogether if the temperature gets too high! Schools can be built very differently and their designs may be better suited or worse suited to extreme temperatures. Different buildings face different issues.

Slide 41: Assess the school buildings to see which parts of the school are exposed to the heat

In France, headteachers are required to assess school buildings to make sure they know which parts of the school can get dangerously hot. They are encouraged to re-organise the use of rooms to avoid those spaces that get too warm on hot days. Cooler rooms are recommended to be used as 'refuges' for children who are overheating, or to move classes to when their own room is too warm. The UK heatwave plan advises: "if possible, use those classrooms or other spaces which are less likely to overheat, and adjust the layout of teaching spaces to avoid direct sunlight on children". We will be thinking about assessing your own school in the next lesson!

Slides 42 - 43: Limit the opening of windows.

It can be tempting to throw all the windows open wide on a hot day, but this can sometimes make a room even hotter. Unless there is a chance for the air to be pulled through your classroom and out somewhere else (perhaps the windows of another nearby classroom, or a skylight in the adjoining corridor) opening the window on a hot day won't help much. Once the temperature outside the classroom is as hot, or even hotter than the air in the room, it's only going to make things worse. Ideally windows should be opened at night, if it's secure to do so, in order to release any hot air trapped in the school during the day. If not, it's best if they are only opened very early in the morning, before it gets too hot, and then almost closed again in the afternoon, allowing just a bit of ventilation.

Slide 44: Use blinds to block out the sun, if appropriate

If the classroom has blinds, these can help to prevent very strong sunlight from entering the classroom. However, they need to be used carefully. Dark blinds can actually end up absorbing heat and trapping it in the room, especially if they also interfere with ventilation.

Slide 45: Use sun shades if they are fitted

Some schools have sunshades fitted to their windows, particularly if the building is South facing. Why might the direction that the building is facing be important? Explain that a South facing room gets a lot of sunlight during the warmest hours of the day, so is likely to heat up more than those facing in other directions, unless it is well shaded in other ways. Sun shades can be effective, but they are expensive to fit and, like blinds, they can sometimes end up affecting the ventilation in the classroom.

Slide 46: See whether you can move to a cooler classroom or have lessons in a shaded spot outside.

If your classroom gets too hot, it might be possible for you to move to a cooler room in the school. You might be able to have some of your lessons outdoors, if there is a suitably shaded area. We'll be exploring some of these ideas in the next lesson.

Slides 47- 48: In some countries, schools close once the temperature reaches a certain level.

In France, a red alert for '*canicule*' (heatwave) means that schools shut. France is quite used to high temperatures, so this red alert is only triggered when it's very hot. As we have already seen, a heatwave depends on the temperatures rising to a level higher than is usual for an area. So a *canicule* is declared in Paris once the weather is over 31°C during the day, but in Marseilles, it would have to get to 36°C. You could use this opportunity for further mapwork with pupils - look at the locations of these different areas (Paris and Marseilles) and discuss why the latter might be hotter (Marseilles is further South).

In Germany, where heatwaves have typically not been very common in the past, buildings are not designed to cope and the level for declaring an alert is much lower. Workplaces and schools have to take action to adapt their buildings if they regularly reach 30°C, but schools and workplaces may close at lower temperatures. The term for a school closing is "*Hitzefrei*" which literally translates as 'heat free' and means people can go home to escape the heat. In Bremen, *hitzefrei* is declared if the temperature reaches 25°C. Again, you could explore why this part of Germany might be generally cooler by looking at a map of the country (it is further North).

Not everyone in German schools gets a day off though. Parents have to agree to it as it can disrupt their working day too much if their children are sent home. In Saarland, parents requested that *Hitzefrei* be abolished in 2006.

Slide 49: DISCUSSION ACTIVITY - Work in pairs and feed back to your group. Remember how the UK Heatwave plan suggests that a fan can be used in classrooms **up to 35°C**? This suggests that pupils would be expected to remain in school in high temperatures like these. The plan also recommends limiting outdoor activities after the temperature reaches 30°C, yet the UK heatwave threshold for some locations is actually below this temperature. Meanwhile, in other countries, children are sent home if their classrooms reach lower temperatures than these.

In Summer 2022, the UK experienced temperatures that were much higher than this and some schools closed. Did yours?

At the moment, there is a minimum temperature at which schools are allowed to be open (the lowest recommended temperature is 16°C; individual schools may have their own policies) but there is no maximum temperature. Do you think that this should be reconsidered now that we are likely to see more heatwaves in the future?

SUGGESTED FOLLOW UP ACTIVITIES

Make posters to alert staff and each other to the signs of heat related illness

Use the government guidance on what to look out for when a person has developed heat stress, heat exhaustion or heat stroke. These could be presented during an assembly so that children all understand the need to stay cool during hot weather and so that they can look out for each other and get help if needed.

<https://www.gov.uk/government/publications/heatwave-plan-for-england/looking-after-children-and-those-in-early-years-settings-during-heatwaves-for-teachers-and-professionals>

Interview members of the school community about their experiences of extreme heat

Arrange to hold interviews with people who work in various parts of the school, to find out their experiences of extremely hot days. The school cook, for example, might have to work in an already hot space. This information can feed into the work carried out in Lesson 3, particularly if you are carrying out these lessons at a time of year that is not actually hot enough to take useful temperature measurements.

Debate: “Should schools close if temperatures reach....?”

Carry out a debate on the subject of school closures during a heatwave. Some arguments you may want to consider include:

For closing: Danger to health; inability for people to concentrate; harder for teachers to look after lots of heat-exhausted children; too expensive to adapt schools.

Against closing: Disruption to learning; disruption to parents (especially if they have children at several different schools); loss of earnings if parents can't work; it's a short-term solution - we should adapt schools instead, people's homes may also be too hot.

A very useful resource with many of the temperatures reached in the UK during the summer of 2022 can be found here:

https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2022/2022_03_july_heatwave.pdf

4. WHAT IS YOUR SCHOOL LIKE DURING A HEATWAVE AND HOW COULD IT BE IMPROVED?

Learning Objectives:

- **Fieldwork** - children will investigate and map the warmest and coolest places in their school.
- **Children will use their findings to suggest some ways that their school could be adapted to cope during a heatwave.**

SUGGESTED STARTER ACTIVITY

Slide 51: WHAT TYPES OF ADAPTATIONS CAN BE MADE TO SCHOOLS TO HELP DURING A HEATWAVE?

Sorting activity: Building adaptation or behaviour change?

Use the suggestion cards provided and ask children to work in groups to discuss each idea for reducing harm during a heatwave. Which of the ideas involve a behaviour change (that the students could do themselves) and which would involve adapting the school buildings, or changing the way they are used (that would involve decisions being made by the headteacher or school leadership team)? Some might be a mixture - for example, children can wear cool, loose clothing, but only if the school uniform policy allows it.

KEY QUESTION: HAS YOUR SCHOOL ALREADY MADE ANY OF THESE CHANGES?

Think back to a time when you experienced extremely hot weather during a school day (perhaps during Summer 2022). Did your school carry out any of the suggestions on the cards? Are there any that would not currently be possible for your school to carry out?

TEACHER NOTES FOR POWERPOINT PRESENTATION

Slide 52: Where do you think the warmest places in school are? Open a whole-class discussion. Are there classrooms that are well known for being very hot and, if so, why is that? Are they in South-facing buildings? Do they have a lot of windows that act a bit like a greenhouse? Is your outdoor play area shaded anywhere, or are there parts that are in full sun during the warmest parts of the day?

Slides 53 - 55: Are there any classrooms or other locations in your school that are especially hot during warm weather?

Ask the students to consider their own experiences around the school - are there particular locations that they think are hotter or cooler? Where are these places? Students can use the worksheet provided to interview the oldest pupils in the school to see which classrooms they thought were particularly uncomfortable in hot weather. They will record their data on the sheet and then think about ways to analyse and display it.

Slides 56 - 57: Provide or sketch a map of the school and the school grounds

In order to carry out the next tasks, you will need a map of the school. This can usually be provided by the school business manager or caretaker, but will need locating in advance of the lesson and photocopying to an appropriate size.

Alternatively, you can call up a satellite view of the school and use this to make approximate sketch plans (squared paper will help). Don't forget to make separate layout plans for the different floors of the school if appropriate.

You might like to replace the image on slide 56 with a floorplan of your own school, if possible (or a satellite image from Google Maps to aid with making a sketch map).

Slide 58: Measuring the temperatures of places around the school

Before carrying out any fieldwork, you will need to ensure that the children are able to take accurate readings.

- Show the class the thermometer(s) you have available at this point and demonstrate how to read them.
- Most thermometers take about a minute to adjust to a degree change in temperature. In the winter, taking a thermometer from inside to outside, this can mean a long wait!
- Most digital thermometers have an accuracy of +/- 3 degrees Celsius – this means you can only really compare readings made by the same thermometer, unless you compare thermometers when they are in the same place and see what the differences are.
- In direct sunlight, the sun will warm the thermometer up and make the reading inaccurate.

59: Fieldwork activity - work in groups: Which ARE the warmest and coolest parts of the school when it is warm and sunny?

If you are carrying out these lessons during the summer, it should be possible to take measurements in several different locations. If not, you may need to rely on the anecdotal evidence gathered from interviews (slide 53 above), together with a school tour to attempt to identify the reasons that certain rooms / locations have a reputation for being really warm.

There are many opportunities for pupils to carry out extensive geography and science fieldwork here, but the level at which you do this will depend on the time and resources you have available. You might:

- Use plans of the school to colour areas of the school believed to be cool and warm during hot weather.
- Annotate these maps with notes and sketch plans of the reasons for rooms being warmer, such as the direction of windows.
- Set up thermometers in certain classrooms / outdoor areas and monitor them over a day/ series of days in order to obtain readings to

inform further work. **(You could use the simple temperature recording sheet provided to assist with this)**

- Experiment with the effect of using blinds, or opening different windows on air temperature in a given location.

Your findings could be presented in a range of ways - there are many links that can be made to maths and IT here.

Slide 60: WHAT ACTIONS COULD YOUR SCHOOL TAKE TO BE BETTER ADAPTED FOR HEATWAVES?

Your fieldwork will then give you some ideas about where the hottest parts of your school are.

You can now start to consider whether there are any measures that could be put in place to adapt your school buildings during a heatwave. You may want to revisit ideas from Lesson 2 and from your sorting activity at the start of this lesson.

When you look at the findings from your research, consider who will be most affected by these results in the event of a heatwave? Are there particular year groups or classes who have to be based in especially hot places? Do some children have break times in non-shaded areas? Are there particular lessons that are always taught in very hot rooms?

Slide 61: Revisit ideas from Lesson 2

Maybe your school already uses some of the ideas from the UK Heatwave Plan that we looked at in lesson 2. Perhaps there are some ideas that might be possible in the future. There will be pros and cons to each idea. Some other possible solutions that your school could investigate include (see following slides):

Slide 62: Are your school radiators set to come on automatically?

In the UK, one real problem during the summer months can be the school heating system. This is often set to come on automatically in the morning all over the school, regardless of how warm the classroom gets later in the day. Teachers and pupils are forced to open the windows if it gets too hot and the heaters can't be turned off. Hot air from outside is then pulled into the classroom, heating it up even more. Do you know if your school heaters are on a timer? Can each classroom turn their own heaters down or off, or are they set automatically? Changing this can make a big difference to how comfortable your classroom is during hot weather - as well as preventing your school from wasting energy and money.

Slide 63: Make use of the Albedo effect

If you have ever been to a very warm country, or a sunny beach-side place in the UK (the picture on the right shows houses in Greece) then you may notice that buildings are often painted white. This is largely because of something called the 'Albedo effect' - pale colours are able to reflect more light (and heat) away from the building, whereas dark colours absorb them. You can test this theory by rolling one bottle of water in white paper and one bottle in black paper and placing them outside on a sunny day before measuring the water

temperature of the water inside them.

If you have dark-coloured roofs and walls on any South-facing buildings at your school, painting these white may help deflect a little bit of the heat on extremely hot days.

Some countries have also tried painting pavements and car parks white to reflect more light and heat. Could you try this at your school by painting areas of the playground or car park? The good thing about this idea is that schools often have large areas of concrete or tarmac that could be painted. Unfortunately, all that reflected heat has to go somewhere. Studies in America found that a person walking on a special reflective pavement felt up to 7 degrees hotter than when walking on a dark surface.

Slide 64: Plant trees and other vegetation.

Did you know that trees are amazing at reducing the temperature? They do this in three ways. They produce water vapour (the transpiration you have learned about in studies of the water cycle) and they also reflect more solar energy back into the atmosphere than buildings and ground covering such as tarmac. You have probably noticed how hot a road or pavement can get on a hot day as it absorbs heat energy. Trees also provide shade under their branches.

A Swiss study, using satellite data from 293 cities across Europe, discovered that areas with tree cover reduced the surface temperature of some cities by 12% compared with buildings or even grassy areas with no trees.

The downside of using trees to create shade and cooling is that they take a long time after planting to reach maturity. Trees that you plant this year may help children many years after you have left school. What do you think of this idea?

Slide 65: Add water features to your outdoor space

Water features such as ponds can also reduce the temperature of the surrounding air (though in reality, you'd need a pretty large pond to notice much effect!) This is because water can absorb more energy than air before it heats up. If you are thinking of adding a pond to your school grounds to help with temperature control, you might want to look at this guide to making one: <https://ypte.org.uk/factsheets/making-a-pond/introduction>

Be aware that rising water temperatures reduce the amount of oxygen in the pond, so if you have fish, you will need to take extra care to monitor water temperature during extremely hot weather.

Slide 66: Minimise harmful emissions from idling traffic

It's a good idea to try to reduce harmful exhaust emissions all year round, but during a heatwave, these can build up and cause real problems - especially for people with asthma and other illnesses. Consider having a 'no idling' policy at school, where drivers are asked to turn off their engines while waiting near the school. This would apply to families and coaches dropping

off and collecting children, teachers and support staff, delivery drivers and refuse collection drivers. Is this something your school already does? How could you communicate this message to drivers?

Slide 67: ACTIVITY: Discuss these possible solutions to managing future heatwaves.

In pairs, a group, or a whole class, discuss your findings from these lessons. By now, you should have some ideas of what a heatwave is, what causes heatwaves, and why they are likely to become more common in the UK. You will understand that they can be dangerous and that many countries have a Heatwave Plan in place to help deal with extreme heat.

You've seen some examples of ways that schools can change the use of their buildings, or adapt them in order to help minimise harm to people during a heatwave. Now that you also know which parts of your school are the hottest, you can start to come up with some solutions that could help. You might want to choose one solution to research in more detail.

KEY QUESTION: WHAT ADAPTATIONS COULD YOUR SCHOOL MAKE TO PROTECT PEOPLE DURING FUTURE HEATWAVES?

Slide 68: Present your findings to your headteacher, leadership team, or eco committee

Once you have considered the pros and cons of the various solutions, you could present your findings in an assembly, or more formally to your headteacher. This could be tied in with literacy work on report writing, persuasive writing and other non fiction topics. More frequent heatwaves are seemingly certain to affect the UK, so being aware of these possible solutions will arm you with useful ideas for the future.

SUGGESTED FOLLOW UP ACTIVITIES

Display on school temperatures

Choose a central location to make a display of your findings about which areas of the school are hottest during warm weather. Provide information on possible solutions that you have discussed. You may want to add an interactive element by providing sticky notes and pens for other people in school to add their experiences of different parts of the school, or to vote on the possible solutions that you have identified.

Heatwaves and solutions explanation writing

Choose the wider subject of heatwaves, or any aspect of potential solutions (such as painting walls and roofs in light colours) and use this as the basis for a piece of explanation writing, with diagrams.

School grounds adaptation project

If you decide to carry out any physical adaptation of your school grounds, such as tree planting, or pond building, this can become an additional topic in itself with many opportunities for measuring, planning, costing and assessing

the results. We'd love to hear about any projects that you undertake!
Please contact us at info@rmets.org or info@ypte.org.uk