BEGINNER'S GUIDE TO SUDS

ACTIVITY BOOKLET

WHY DOES IT FLOOD?

IS IT GETTING WORSE?

WHAT CAN WE DO ABOUT IT?

TREES FOR CITIES

CONTENTS

WHO ARE WE?

Trees For Cities are the only UK charity working at a national scale to improve lives by planting trees in cities. We get stuck in with local communities to cultivate lasting change in their neighbourhoods.

Our work in schools involves transforming school grounds into leafy green oases for both the children of today and for future generations. By working in partnership with children and schools, we reimagine and redesign playgrounds; introducing trees, forest gardens, food growing, outside classrooms and woodland play areas. We also use trees in playgrounds as natural pollution barriers and flood defences.

Rain gardens designed by Trees For Cities.

WHAT IS THIS BOOKLET ABOUT?

This booklet introduces the water cycle and how it links with climate change.

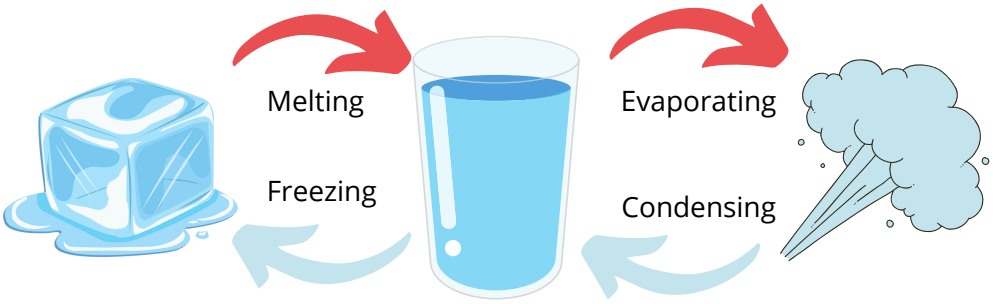
It explains how our cities are are facing increased risk and intensity of flooding.

The activities in this booklet will explain how natural solutions can be used to lessen the risk of flooding in your school.

As climate change continues to alter our environment this booklet will address ways you can conserved water.

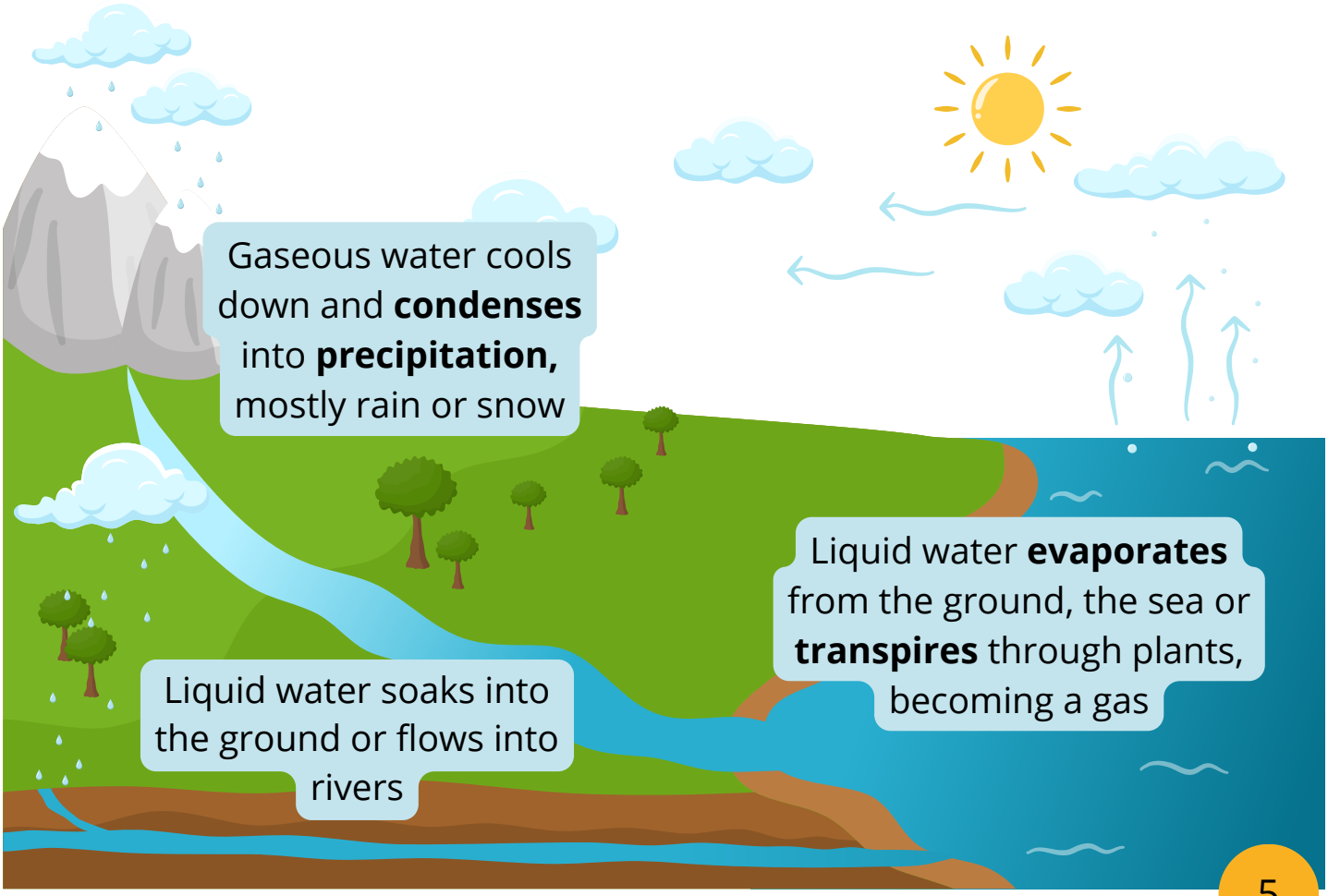
SuDS rain garden with elevated pathway

THE WATER CYCLE



Water can take 3 forms: Solid ice, liquid water and gaseous steam. To go from solid to liquid and then gas, you add energy. The higher the temperature, the faster the water will evaporate.

The Water Cycle describes the different ways that water moves through our weather system



WHY DOES IT RAIN?

When you breathe out on a cold day, you may see your breath in the air like steam.

The cold is causing the water in your breath to condense into tiny visible droplets.

It looks like a cloud because it's almost the same process that makes clouds in the sky.

Water evaporates from the land, rivers and seas. It then rises up into the sky.

At a certain height the water condenses into tiny water droplets called water vapour.

If there is enough water vapour in the air, the droplets will stick together, become heavy and fall as **precipitation**.

WHY DOES IT FLOOD?

When there is more rain than can be absorbed by the ground or taken away by rivers and sewers, then the water will start to cover normally dry areas. This is known as flooding.

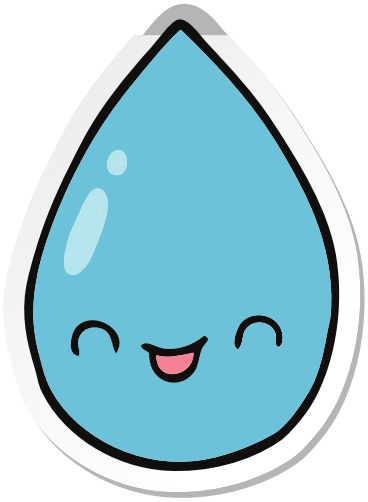
There are 3 main types of flooding:

1. Rain Flooding or Surface Water Runoff (Pluvial) from very intense rainfall causing water to build up and flow over impermeable surfaces

2. River Flooding (Fluvial) – where water in a river exceeds its capacity and flows over its banks and floods nearby land.

3. Coastal Flooding – where high tides, storms or rising sea levels cause water from the sea to flow into low-lying coastal areas

RAINDROP STORY



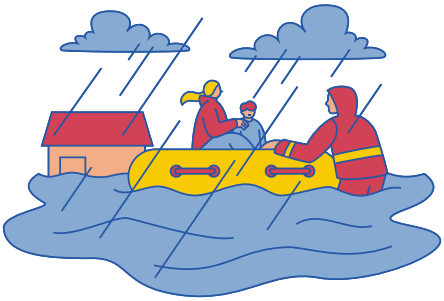
Imagine that you are a raindrop falling to Earth and about to go through the full water cycle. Describe your journey.
Key Words: cloud, river, sea, evaporate, condensation, precipitation

IS FLOODING GOOD OR BAD?

Imagine that a big flood has happened in your area. What could be some bad effects of it?

Now can you think of some reasons why flooding in some places might be good?

Flooding can be bad.



- Flood waters can damage buildings.
- Water can damage and block roads.
- It can bring in diseases that hurt people and animals.
- The flood water may contain pollution.

Flooding can be good.

- Floodwaters may carry nutrients that can enrich the soil where farmers grow food for us to eat.
- Flooding can create habitats for fish, birds, and other wildlife, supporting biodiversity.
- Many animals use floods to move around and find new homes.
- Floods help fill underground water supplies, which we can tap into to use as drinking water.

IS FLOODING GETTING WORSE?

There are two reasons why flooding is becoming a bigger problem:

Urbanisation - More people are living in towns and cities, paving over areas and removing natural drainage systems.

Climate Change - Global temperatures are increasing. This means an increase in all types of extreme weather, including both droughts and storms

URBANISATION

Today, over half the people in the world live in **urban** areas. This is another word for towns and cities, as opposed to the countryside.

To have a city, we need to build over grasslands, remove trees and alter the courses of rivers.

We replace **permeable** surfaces (ie ones that water can soak into), like grass or soil, with **impermeable** surfaces**,** like concrete or paving.

When water lands on a playground, it can't soak into it, so it gathers into pools. We call this surface water flooding.

Cities try to build sewage systems to take the water away more quickly, but these can be very expensive to build and maintain.

Our current sewage system can't always deal with heavy downpours.

PLAYGROUND MAPPING EXERCISE

Print out a view of your school from above (it is easiest to print one from Google Maps, your teacher might need to help you with this).

Colour in all the **permeable** surfaces one colour, the **impermeable** another colour and **trees** a third colour. Finally, think about when it rains really heavily; which areas get either flooded or boggy? Mark those parts with an **X.** Put a key at the bottom of your page. See the example below.

Key:

Permeable**:**

Impermeable

Trees

Floods or bogs

HOW GREEN IS YOUR PLAYGROUND?

Look at your map of your playground. What shape is your playground? How do you calculate this area? You may have to break it down into multiple shapes.

What are the dimensions of this shape? Use a trundle wheel to measure in person or a ruler to measure the map. Add these labels to your map.

What is the total area of the playground?

How much green space do you have? Use the same method.

What proportion is green space?
Use the equation: area of green space / total area = proportion
To get a percentage, multiply your answer above by 100.

CLIMATE CHANGE

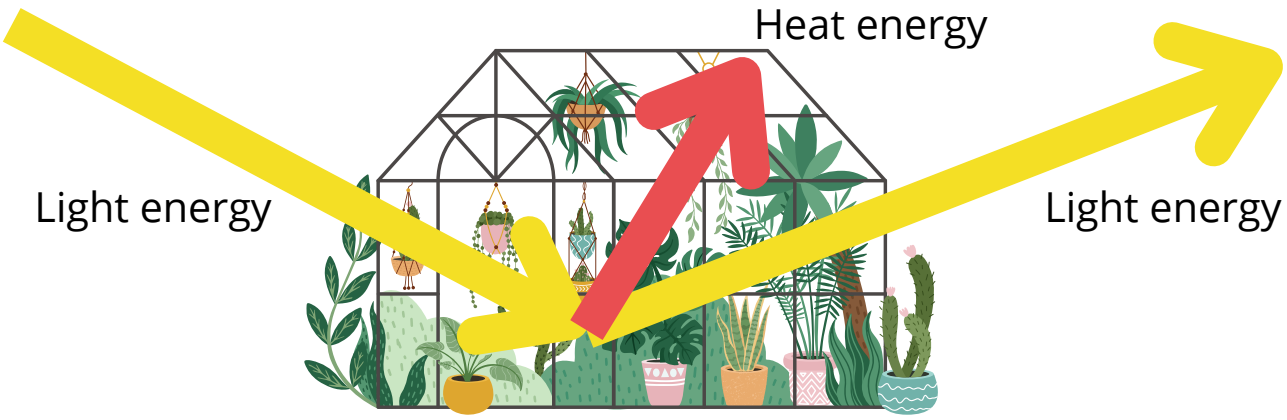
WHAT IS THE GREENHOUSE EFFECT?

Who uses greenhouses? What do they use them for?

Have you ever been in a greenhouse? What's it like?

Greenhouses are used by gardeners. They use them for growing plants.

It is warmer inside a greenhouse than outside, this allows them to grow fruit, vegetables or flowers for longer.



Glass allows light energy to pass through it. That's why you can see what's on the other side. However, it does not let **thermal (heat) energy** get through so easily.

Light from the sun goes into the greenhouse and heats up the objects inside. When they emit thermal (heat) energy, the glass traps it inside so the air starts to warm up.

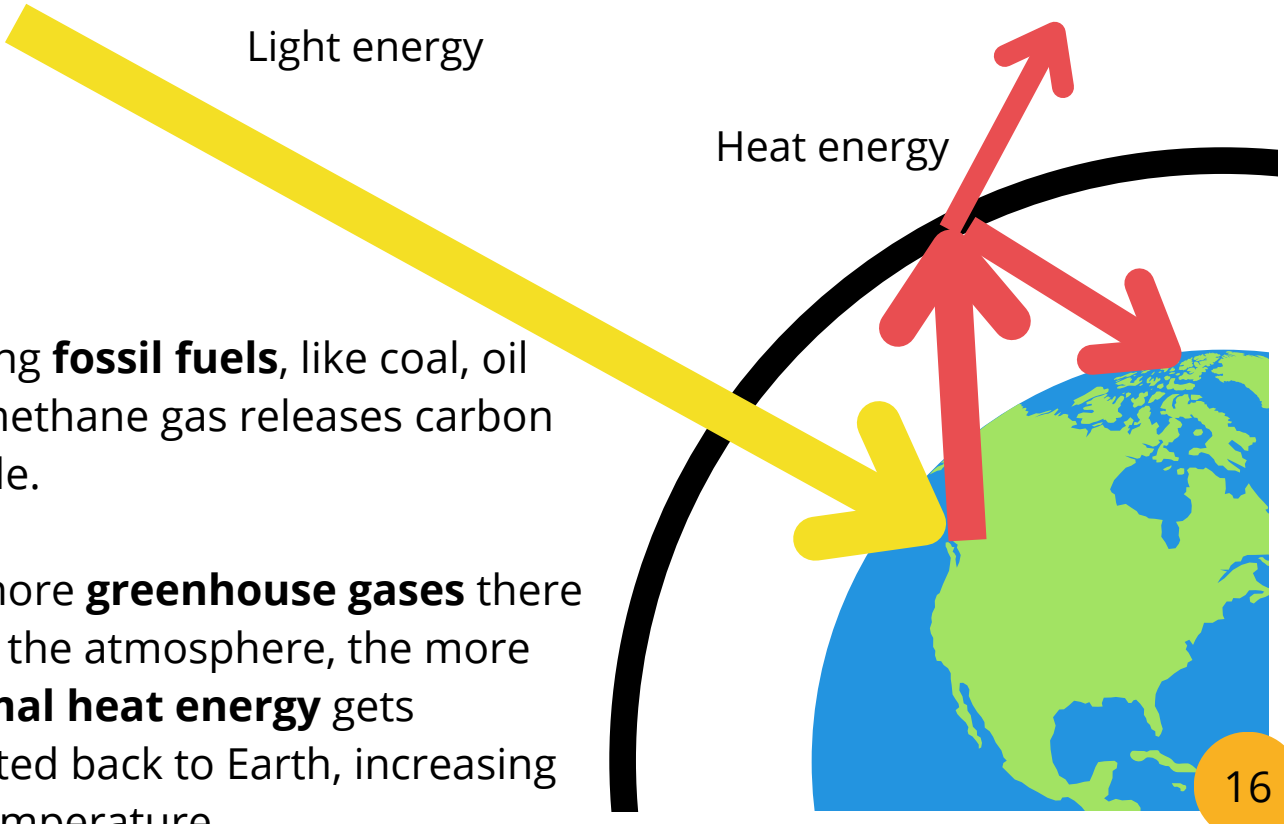
HOW IS THE EARTH LIKE A GREENHOUSE?

The Earth is surrounded by gases; this is called the Earth's **atmosphere**.

It is mostly nitrogen (78%), with oxygen (20%) and small amounts of other gases, including argon, **carbon dioxide** and **methane.**

Like the glass on a greenhouse, **carbon dioxide** in the Earth's atmosphere allows light to come in, but then reflects back some of the thermal heat energy. This is why we call carbon dioxide (CO_2) a **greenhouse gas**.

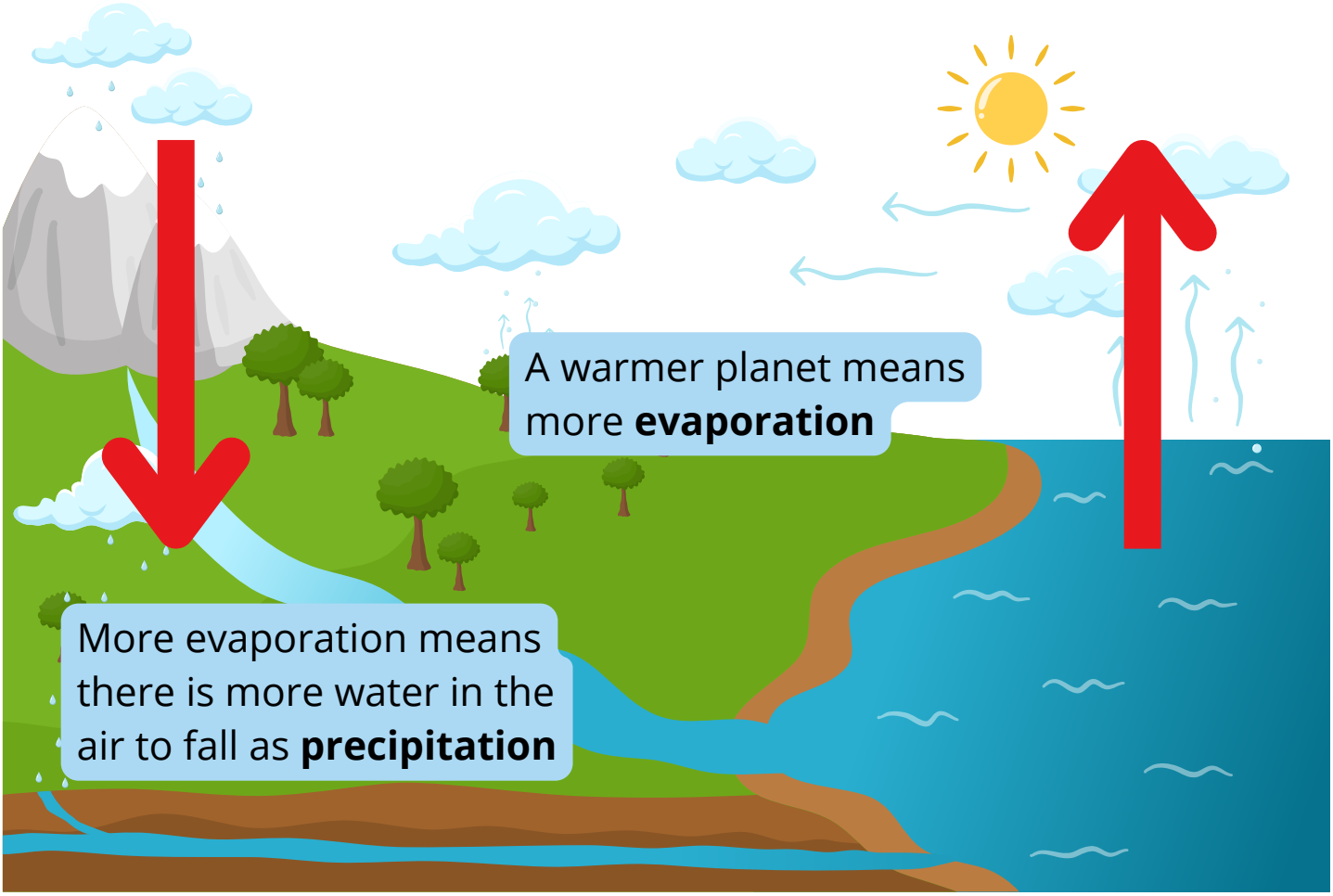
We need the Greenhouse Effect. If we had no greenhouse gases, the Earth would be about 30 degrees colder (-18 degrees on average).



Burning **fossil fuels**, like coal, oil and methane gas releases carbon dioxide.

The more **greenhouse gases** there are in the atmosphere, the more **thermal heat energy** gets reflected back to Earth, increasing the temperature.

DOES THE GREENHOUSE EFFECT MAKE FLOODING WORSE?



When the temperature is higher water evaporates more quickly. This means there will be more water in the air.

We call this **humid weather**. This weather makes you feel sweaty and sticky.

When it is humid, there is more water in the air to condense into rain. Therefore it rains more often and more heavily.

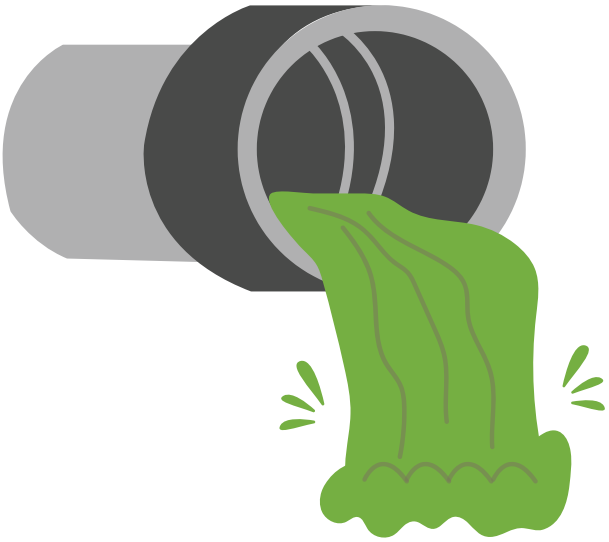
THE GREAT STINK

In most urban areas, floods are dealt with using the **sewage system**. This is a system of pipes and drains designed to take water away from the ground as quickly as possible.

These drainage systems were built in Victorian times thanks to an episode known as the "Great Stink".

In London in 1858 it was a very hot summer. The heat caused the sewage in the river Thames to get very stinky.

People complained about the smell and politicians working beside the river realised it was time to upgrade the sewage system. But, that was over 160 years ago.



The Victorian sewage system does not have the ability to cope with the very heavy downpours we are experiencing today.

We can't keep building bigger pipes as it is too expensive to build and maintain.

So, what else can we do to slow the flow of water into our existing drainage system?

NATURE BASED SOLUTIONS

SuDS stands for Sustainable Drainage System, and it is a way of using nature to reduce some of the effects of flooding.

SuDS take advantage of natures ability to slow down the rate at which water reaches the ground and increases the rate at which the ground can absorb that water.

Even the best SuDS systems, cannot stop all flooding. But they are used to slow the flow of water.

Rain Garden designed by Trees For Cities in Leicester

TREES

If you get caught in the rain, you may run under a tree to keep dry. This is because it takes a while for the water to fall through all the different layers of leaves.

The leaves slow the flow of the rain water.

The tree roots will break up the ground underneath the tree. This allows water to be absorbed more easily into the soil.

The roots then absorb the water from the soil.

RAIN GARDENS

We can change impermeable surfaces into ones that are permeable - in areas that flood.

One solution is to create a rain garden in those areas.

It can be filled with trees and plants that thrive in normal weather conditions but also are able to cope with flooding too.

SWALES

Grass and soil are a lot more permeable than paving or tarmac.

If you dig a ditch in the ground where the water naturally pools, you allow the water to soak in more easily. This prevents water from spilling out onto areas that people use.

DRAINPIPE PLANTERS

When it rains, all the water that lands on roofs is sent down the drainpipes.

In heavy rain this can easily overwhelm their capacity, causing water to flow onto the ground and cause a flood.

Here water is diverted from the drainpipe into a planter that can take some of that water before it floods.

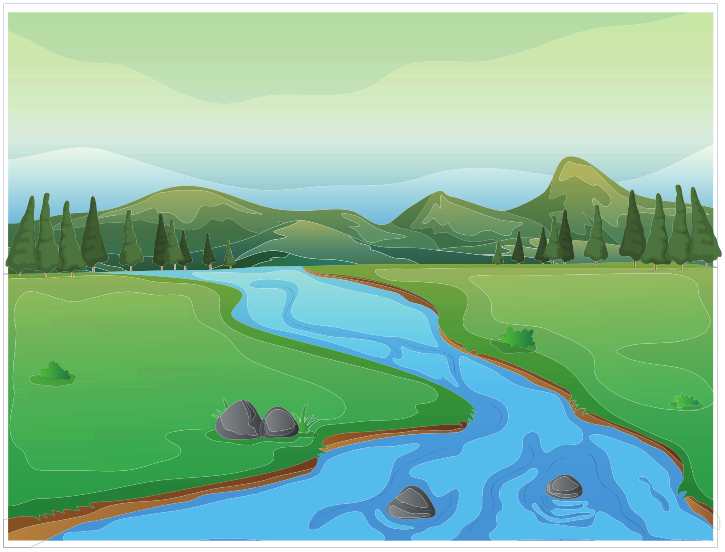
The plants used can thrive in normal weather conditions but are also able to cope with flooding too.

Water from the white drainpipe is going directly into the planter

REWILDING RIVERS AND MEADOWS

Many **canalised** rivers are being returned to a more natural state, where they have been given back their **meanders** and grassy banks.

Reintroducing beavers, who fell trees and build dams, will mean that the water gets held up upstream and is less likely to flood in cities.



WHY CHOOSE NATURE BASED SOLUTIONS?

There are many benefits to nature based ideas. In addition to being cheaper to build and maintain than sewage systems, SUDS bring all the other advantages that nature brings us:

- Absorbing and storing carbon dioxide
- Reducing the amount of air pollution
- Providing a habitat for wildlife and increasing **biodiversity**
- Being good for our mental and physical health
- Making our cities nicer to live in for us and other animals

PLAYGROUND MAPPING EXERCISE

Go back to your map of the school. Think about which SUDS systems you can use. Mark them on your map. Make a new key at the bottom.

- What needs to remain where it is? What can't we change?
- Where does the water pool? Put in a swale, tree pit or rain garden
- Where does the water run off? Put in some trees or grass
- Where are there drainpipes? Put in a rainwater planter

Key:

Swale

Rain Garden

Tree Pit

Rainwater planter

WHAT TO DO IF THERE IS A FLOOD

What do you do in your school in case of a fire? Its probably something like this:

1. Someone sounds the fire alarm
2. A responsible adult calls the emergency services
3. Follow all instructions given by the teacher
4. Leave all your things behind
5. Calmly evacuate the building to an agreed point outside
6. Wait silently in a line outside while the teacher does the register, to ensure that no one has been left inside
7. This should be practiced at least twice a year so that everyone knows what to do in case it happens.

Find out what your school flood drill is? Write the steps below

CLIMATE CHANGE QUIZ

1. What do we call it when water changes from a liquid to a gas?

(a) Melting
(b) Evaporation
(c) Condensation
(d) Precipitation

2. What is the scientific name for rain and snow?

(a) Melting
(b) Evaporation
(c) Condensation
(d) Precipitation

3. What does permeable mean?

(a) Allows water to get through
(b) Does not allow water through
(c) A good habitat
(d) A bad habitat

4. Which of the following is **not** a type of flooding?

(a) River flooding
(b) Coastal flooding
(c) Surface water runoff
(d) Lake flooding

5. What is the main reason gardeners use greenhouses?

(a) Keeps plants cool
(b) Keeps plants dry
(c) Keeps plants warm
(d) Lets the gardener look at their plants from the outside

6. Which of the following is **not** a greenhouse gas?

(a) Carbon Dioxide
(b) Nitrogen
(c) Methane

7. Why are greenhouse gases called greenhouse gases?

(a) They are produced by greenhouses
(b) They were discovered in a greenhouse
(c) They are good for plants like a greenhouse
(d) They trap heat like a greenhouse

8. True or false: We need some greenhouse effect.

(a) True
(b) False

9. Warmer temperatures can lead to more rain because:

(a) It increases the amount of water in the seas and oceans
(b) It increases the rate of evaporation
(c) Clouds prefer to form in warm air
(d) People use more water on warm days

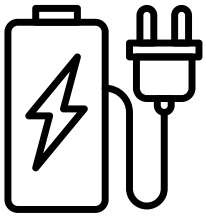
Can you answer all of these questions?
Answers at the bottom of page 33.

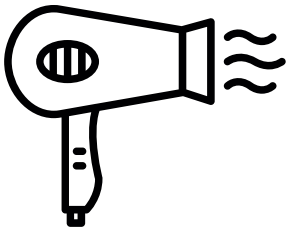
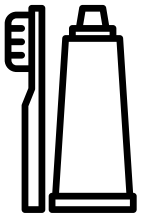
WHAT DO YOU NEED IF IT FLOODS?

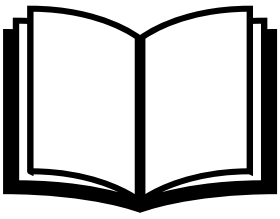
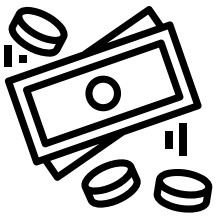
A flood is a bit different from an emergency caused by fire. With a flood, you generally have more warning and time.

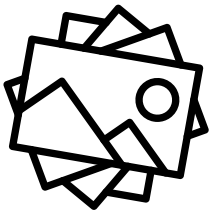
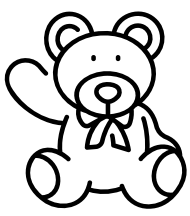
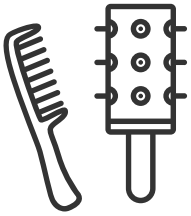
However, you might get **stranded.** Therefore, its a good idea to have an easily accessible **grab bag** with some important items that you might need.

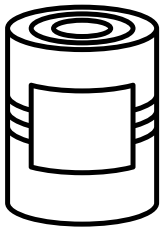
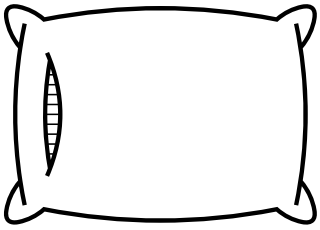
Below is a list of items. Circle the ones that you think are important to take with you in case of a flood.



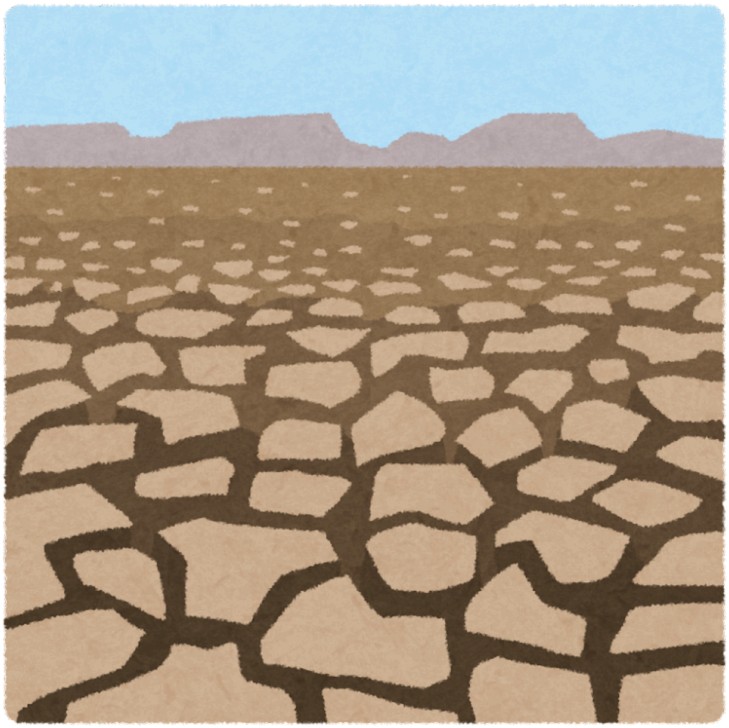




WHY DO WE NEED TO SAVE WATER?

Remember that climate change means an increase in the likelihood and severity of all types of extreme weather, including both storms and **droughts**.

We will need to learn to capture, store and conserve water where possible.



HOW MUCH WATER DO YOU USE?

In one day, count how many times you do each activity and put it in the total column. “How much water?” tells you an estimate of how much water you use each time you do it. Multiply these two numbers together to get an idea of how much water you used in total.

Activity	Total	How much water?	Total water
Pouring a glass of water		1l	
Washing hands		5l	
Brushing teeth		10l	
Using dishwasher		15l	
Using washing machine		60l	
Flushing toilet		10l	
Having a shower	minutes	8l/min	
Having a bath		80l	
		Total:	

REDUCING YOUR WATER USAGE

What things can you do in each room of your house to reduce water usage?

To help you, ask your teacher, parents or the internet for some ideas.

The Kitchen

Think about what activities you do in the kitchen. What are some ways you could use less water?

The Bathroom

We use a lot of water in the bathroom. Think about which things you do that use the most water; how could we make them more water efficient?

Outside

If you have a garden (or maybe your school has a garden), how can you use less water here? Can you make your shopping more water efficient? Research how much water goes into making your food and clothes.

GLOSSARY

Atmosphere - The mix of all the gases that surround the Earth

Biodiversity - The total variety and number of species in an area

Canalised - When a naturally flowing river gets turned into a canal, generally making it straighter, deeper and with embanked sides

Carbon Dioxide - A greenhouse gas, released by burning fossil fuels such as coal and oil.

Climate Change - The change in global weather systems (over a long period of time) caused by carbon dioxide in the atmosphere

Evaporation - When liquid turns to a gas (NB - this happens at every temperature, unlike boiling, which happens at the boiling point)

Flood - When water lands on an area more quickly than it can be removed or absorbed, causing normally dry areas to be covered in water

Flood plane - The area around a river that water overflows into

Fossil Fuels - Coal, oil and methane gas. They are non-renewable and release carbon dioxide when burnt.

Grab bag - Sometimes called an “emergency bag”. A bag with useful items kept so you can quickly get it during an evacuation.

Greenhouse Gas - Gases that help trap thermal energy in the Earths atmosphere, increasing global temperatures.

Humid weather - When there is a lot of water vapour in the air. It feels sweaty and sticky.

Impermeable - Surfaces that do not absorb water

Meander - Bends in a river

Methane gas - Sometimes called “natural gas”, its a fossil fuel and a greenhouse gas

Permeable - Surfaces and substances that absorb water

Precipitation - When water falls from the sky, for example as rain, snow or hail

Rain Flooding - See Surface Water Runoff

River Flooding (Fluvial) – where water in a river exceeds its capacity and flows over its banks and floods nearby land

Stranded - When you are stuck somewhere

Sustainable Drainage Systems (SuDS) - When you use natural methods, like planting trees and removing paving to reduce the risk and severity of flooding.

Surface Water Runoff (Pluvial)- When rain lands on impermeable surfaces, runs downhill and causes a flood

Swale - An area of low ground for rain to run into. Can be natural or artificial.

Transpiration - When water gets taken up by trees and plants and evaporates through holes in the leaves

Thermal energy - The type of energy stored in hot objects

Urbanisation - The general movement of people from the countryside to towns and cities

Answers to the quiz on page 27
1c, 2d, 3a, 4d, 5c, 6b, 7d, 8a, 9b.

TREES FOR CITIES

www.treesforcities.org

Cyfoeth Naturiol Cymru
Natural Resources Wales