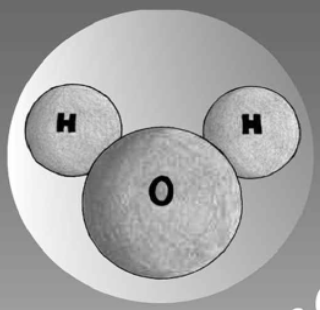
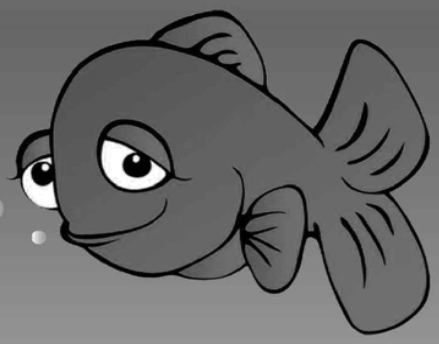
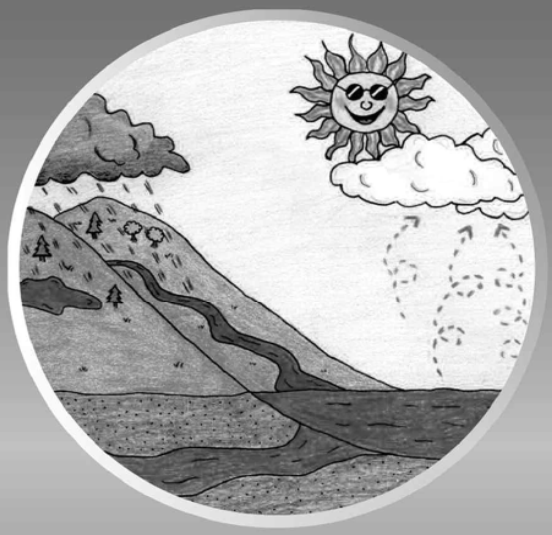


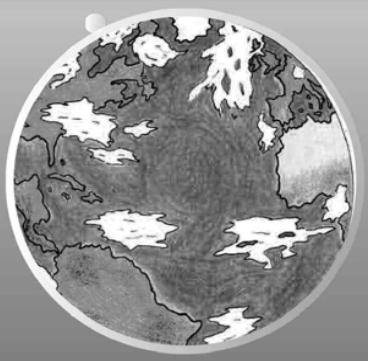
Teachers Resource Booklet

All About Water

Water Education for Primary Schools







4th Class Module

Lesson 1: What's so good about water and where can we find it?

Lesson Objectives:
To study the importance of water and where it may be found.

Lesson Plan:
- Why is water so important?
- How long can a person live without water?
- Where can water be found? (Oceans, seas, rivers, lakes etc).
- Activity: Water Taste Testing.

Materials Required:
- Paper/plastic cups
- Cold water
- Tonic water (must contain Quinone)
- Sugar
- Salt
- Lemon juice

Explain to the class that water is life. It is essential for the life of every organism on our planet. Where there is no water at all, life cannot exist and therefore water may be the most important substance on earth. It is important that we understand it and that we protect it for our future and for the future of our planet Earth.

For some creatures (e.g. fish) even a minute without water is too much. For them, water is home. They need it to breathe, to feed and to move from place to place.

When water is so badly polluted that it has no oxygen, or when it dries up, it means certain (and quick) death for these creatures.

Q. Ask the class if they can name any animals or insects (apart from fish) that live in water?
(e.g. Whales, dolphins and freshwater shrimps).

Q. Ask the class if they can name any animals that live both on land and in water?
(e.g. toads, frogs, newts, snakes, otters, water rats, voles, crocodiles etc).

Activity: Pick two flowers. Put one into a vase with water and the other into a vase without water. Leave them in a room side by side and see which one shrivels up first.

Q. Reinforce the issue of the importance of water by asking the class if they know how long a person can survive without it?

Is it:
a) 1 week?
b) 3 weeks?
c) 3 months?
d) 1 year?

Answer. A) A person cannot survive for more than 1 week (depending on conditions) without water but can survive for 30 days without food.

Explain to the pupils that it's not just fish and humans that depend on water for life. Without water, birds, animals and insects cannot survive for long. Without water plants dry up and will not grow. Without water, the earth turns to desert (these can be either very hot or very cold but they are always dry).

Of course, there are animals and plants that have adapted to living in deserts, but even they need water from time to time. To get it, they have to go to an oasis. An oasis is a green area in a desert where plants can grow because there is water present.

Q. Ask the class if they can suggest what plants or animals are likely to be at an oasis?
(e.g. cactus, palm trees, camels, elephants, antelope)

The more inhospitable the desert, the less plants and animal will be found.

Activity: Ask the class to draw a hot desert with a busy oasis!

Q. Below are the names of two deserts: one is the biggest hot desert, the other is the biggest cold desert. Ask the pupils which is which. Try to find them on a globe.

Answer:
The Gobi – Biggest cold desert
The Sahara – Biggest hot desert

Irrigation is when water from rivers or other sources is diverted through pipes or through channels in fields to help plants grow in dry countries and even in deserts. So much water is used in this way that some rivers are nearly dry by the time they reach the sea!

Here are some other reasons why water is so important:

- We need it to stay healthy. Without water we can't clean our clothes, brush our teeth or wash ourselves. Without water we would stink!
- We also need water to make things that neither taste like water, nor look like water. For example, without water there would be no chocolate, no ice-cream, and no fizzy drinks! There would be no sweets of any kind! In fact, there would be nothing to eat at all!
- What about the fun that water brings to our live? Swimming, snorkelling, sailing, water-skiing, surfboarding and fishing.

That is how important water is to us!!

Q. Which of the following could not exist without water?
A frog, an ice cream cone or a television?

Answer: None of them! Explain to the class that nothing can exist without water. Frogs need it to survive and it is required to make ice cream! Huge amounts of water are required in the manufacturing process of televisions. Also, if there was no water, there would be no people and therefore no one to make televisions!

Ask the class if they can think of anything on earth that isn't made from water or need water to survive.

Activity: Using the letters of the alphabet, ask the class to make a list of all the things that we wouldn't have without water!

e.g. A – alligators, amusement parks, animals, atmosphere, apples, aquariums, astronauts…

B – babies, balloons, bathrooms, baths, batteries, birds, boats, books, brains…

C – carrots, cows, coffee, cookies, clothes, chicken, chips, chocolate, cities, clouds, countries, computers…

D – dairy products, desserts, dinner, dish washers, diving boards, dogs…

E – ears, elephants, earth, Easter eggs, elastic bands, Eskimos, estuaries…

F – faces, farms, fish, flowers, fig rolls, fizzy drinks, food, forests, fruit, fudge…

G – gardens, golf courses, grannies, gorillas, glaciers, glue, grass, gravy…

H – ham, hamburgers, hay, hills, honey…

I – igloos, ice-rinks, ice-cream, ink, insects…

J – jig-saws, jam, jaffa cakes, jelly…

K – ketchup, kitchens, kellogs cornflakes, kaleidoscopes, kettles, kangaroos…

L – lemonade, lollipops, lakes, ladybirds, land, lawns, lawnmowers…

M – malteasers, mud, mayflies, milk, mountains, muscles…

N – newspapers, neighbours, noodles, north pole, nails, nature…

O – ocean, oil, oranges, orange juice, otters…

P – pacific ocean, puddles, paint, pancakes, paper, parks, pasta, people, pizza, pets…

Q – quaking ducks, queen bees, quilts…

R – rabbits, rain, railways, rain forests, rainbows, rashers, restaurants, rivers…

S – saliva, salmon, sand, sandwiches, scrambled eggs, seas, seals, ships, showers, snow, snow-flakes…

T – tea, taps, tears, toilets, trees, thumbs, towns, toys…

U – umbrellas, uncles, ugly ducklings…

V – vanilla ice-cream, vegetables, vapour, vinegar, vitamins, voices…

W – washing machines, wellingtons, whales, windmills, wood, watches, wetlands…

X – x-box, x-ray, x-men, xylophone…
Y – yogurt, yo-yos, you…

Z – zebras, zoos, zoo keepers…

In ancient times, rivers and good springs were considered so important that they were sometimes given the names of Pagan gods. Some wells were thought to have healing powers and these were much revered and protected.

When Christianity was introduced to Ireland, the best spring wells became associated with holy men and women who spread the faith, including St. Patrick and St. Brigid. These 'holy wells' became places of pilgrimage.

Activity: Ask the class if they have ever visited a holy well or if they know of any in their area? What 'cures' and 'healing' powers are associated with them?

Water has also been important for transport. When Ireland was covered in forests, rivers and lakes were the best (and sometimes the only) means of moving people and goods from place to place.

Because of the importance of water, people built their homes as close to good drinking water supplies as possible. In some cases, homes were built in artificial islands (crannogs) on lakes, as these provided security from wild animals and from enemies. And in time, as villages, towns and cities developed, these too were usually located on or close to waterways.
Q. Can you tell which rivers the following cities are built on?

Answer:
Dublin – River Liffy
Belfast – River Lagan
Cork – River Lee
Limerick – River Shannon
Derry – River Foyle
Waterford – River Suir

Where can we find water?
Water is found pretty much everywhere on planet Earth, including the atmosphere and the frozen polar ice-caps. **(A simple definition for atmosphere is that it is the layer of gases that surrounds the Earth).**

Water covers approximately three-quarters of the earth's surface. It is therefore easy to think of it as an endless resource. Explain to the class that this is not the case. Of all the water on the planet, more than 97 percent is found in the oceans as salt water. Of the remaining 3 percent that is fresh water, two-thirds is frozen in ice caps, glaciers, and on snowy mountain ranges. Only approximately one-half of one percent of all the water on the Earth is usable fresh water. Of this amount, it is estimated that there is 30 to 50 times more water found in aquifers (underground), than in all the rivers, lakes, and streams on the surface. Most of the water we use, however, comes from these surface waters.

Q. Ask the class if they can name any of the Earth's oceans? There are five in all:

Answer: Pacific Ocean, Atlantic Ocean, Indian Ocean, Antarctic Ocean, Arctic Ocean.

Q. Ask the class if they know which is the largest ocean?
Answer: The Pacific Ocean.

Q. Ask the class if they can name any of the Earth's seas?
e.g. Irish Sea, Adriatic Sea, Baltic Sea, Mediterranean Sea, North Sea, Dead Sea etc.

Explain to the class that seas and oceans are full of salty water that is not good to drink because, like oceans, they are salty. Even so, in some countries treatment plants take the salt out of seawater so that it can be used (desalinisation process). This is very expensive to do and it takes an awful lot of energy.

Q. Ask the class if they have ever swallowed sea water. What did it taste like? Would they like to drink it everyday?

Explain to the pupils that freshwater may be found in rivers, lakes and streams. We have many of these in Ireland (show the class a map of Ireland that contains the main rivers and lakes). Ask them if they can name any rivers or lakes in their localities.

Explain to the class that all lakes, rivers and streams have fresh water that might be good to drink, but only if that water is clean and has been treated appropriately.

Water treatment is the process of cleaning water and making it safe for people to drink. Water is a very good solvent and therefore it picks up all kinds of contaminants. In nature, water is not always clean and safe enough for people to drink. Our drinking water comes from both surface and groundwater. Water in lakes and rivers may contain impurities that will make it look and smell bad. Water that looks clean may contain harmful chemicals or bacteria and other organisms that can cause disease.

Water treatment plants clean drinking water by taking it through some or all of the following processes:

1. Aeration: This is the first step in water treatment. It involves exposing the water to circulating air, which adds oxygen to the water and allows gases trapped in the water to escape.
2. Coagulation: This is the second step in water treatment. Dirt and other suspended solid particles are "stuck together" chemically so that they may be removed from the water.
3. Sedimentation: This is the third step in water treatment. It occurs when gravity pulls particles to the bottom of a tank.
4. Filtration: This is the fourth step in water treatment. It involves passing the water through a porous mass (e.g. membrane, sand etc) in order to separate out any particles that may be in suspension.
5. Disinfection: This is the final step in water treatment. It involves the use of a chemical and/or other means to kill harmful microorganisms in the water.

There are also vast amounts of water underground that we cannot see, except when they come to the surface as spring wells, rivers or turloughs. In some countries underground water bursts out as geysers! One of the most famous ones can be found in Yellowstone National park in America.

Experiment: Taste Test

Aim: To show that by adding different substances to water, you can change how it tastes!

Materials needed:

- Paper/plastic cups
- Cold water
- Tonic water (must contain Quinone)
- Sugar
- Salt
- Lemon juice

Method:

1. Divide the cups into 5 groups.

2. Pour bottled water into the first group; tonic water into the second; lemon water solution (2 teaspoons of lemon juice in water) into the third; sugar water solution (2 teaspoons of sugar in water) into the fourth and salt water solution (2 teaspoons of salt in water) into the last group.

3. Let the class taste all 5 solutions and fill out the 'Taste Test Tables' by ticking the relevant boxes! Which solution tastes the best?

Lesson 2: Understanding Water!

Lesson Objectives:
To find out what water is, where it comes from and where it goes (water cycle).

Lesson Plan:
- What is water? (H_2O molecule).
- The three forms of water (solid, liquid, gas).
- The stages of the water cycle.
- Experiment: Liquid to vapour and back again.
- Experiment: Water vapour to liquid.
- Experiment: Water cycle.
- Where does water go?
- Distribution of salty and freshwater.

Materials Required:
- A transparent kettle
- Water
- A container, e.g. glass or cup
- A large spoon
- Oven gloves for holding the spoon
- A drinking glass
- Ice cubes
- Potted plant
- Plastic bag (see through)
- String/elastic band
- Dish
- 1000ml graduated cylinder (or 1litre container)
- 5 x 100ml graduated cylinders (or small jars)
- Medicine dropper
- Food colouring

Explain to the class that in lesson 1 they learned how important water is and where it may be found. In this lesson they will find out what water is, where it comes from and where it goes.

Explain to the class that scientists call water H_2O. This means that each water molecule consists of one oxygen and two hydrogen atoms. In shape, a water molecule resembles a "Mickey Mouse" head. There are billions of water molecules in a bottle of water. In its pure form, water is a good solvent, i.e., it can dissolve or mix with many substances. In fact, water has been called the "universal solvent" because of its ability to dissolve other substances.

Water is one of the most amazing substances on the planet. It can be found in all three states of matter (liquid, solid, and gas) on earth, most often in the liquid state.

Ask the class if they can give examples of each of these states:
1. **Solid Water:** Snow, ice, frost and hailstones are all examples of solid water. Liquid water freezes at 0°C. Degrees Celsius is the scale that we use to measure temperature. We see solid water outside in winter when the weather gets really cold, or we see it in the freezer compartment of our fridges.
2. **Liquid Water:** Rain, rivers, lakes, seas and dew are all examples of liquid water. All you have to do is turn on your taps to see liquid water.
3. **Water Vapour:** Steam and clouds are examples of water vapour (gas). Water vapour is sometimes invisible so you may not always be able to see it. Liquid water can change to water vapour by evaporation. Water can evaporate or disappear with the help of heat, like wet clothes drying on a clothesline. To see water vapour all you have to do is boil the kettle or look up at the sky. Water vaporises (boils) at 100°C.

Explain to the class that water moves in a never-ending natural cycle, so the water you are using may have been a drink for a dinosaur! The forms of water are always changing. They move from sky to earth and back to the sky again. This is called the water cycle. Water falls to earth as precipitation (e.g. rain or snow). Some of the water soaks into the ground where it is stored as groundwater. The rest flows into streams, lakes, rivers, and oceans. The sun warms surface water and changes some of it into water vapour. This process is called evaporation. Plants give off water vapour too in a process called transpiration. The heated water vapour rises into the sky and forms clouds. When the vapour in the clouds condenses, it falls back to the earth as rain or snow. The water cycle has then come full circle and begins again.

There are four main stages in the water cycle:
1. **Evaporation:** This is when warmth from the sun causes water from lakes, streams, ice and soils to rise into the air and turn into water vapour (gas). Water vapour droplets join together to make clouds!
2. **Condensation:** This is when water vapour in the air cools down and turns back into liquid water.
3. **Precipitation:** This is when water (in the form of rain, snow, hail or sleet) falls from clouds in the sky.
4. **Collection:** This is when water that falls from the clouds as rain, snow, hail or sleet, collects in the oceans, rivers, lakes, streams. Most will infiltrate (soak into) the ground and will collect as underground water.

(Groundwater: water that has infiltrated into the earth and is stored in usable amounts in the soil and rock below the earth's surface, water within the zone of saturation).

We can't see groundwater like we can see a lake, a stream, or the ocean. This water collects below the earth's surface in aquifers, spaces between rock and soil particles. It may also be found in cracks and crevices and inside porous rocks. The top surface of groundwater is called the water table. When the water table is high enough, groundwater may come to the surface naturally in the form of springs, lakes, ponds and rivers, and it can also be brought to the surface by drilling wells. But the top level of the groundwater (the water table) is usually underground. Groundwater is a vital part of the water cycle and is replenished by rainfall.

The amounts of groundwater in different parts of the world vary, and the amount at any one place can change due to drought, heavy withdrawal for use by humans, or other factors. Groundwater quality is generally better than that of surface water quality because it is not as readily exposed to pollution sources. The movement of groundwater through layers of soil and rock also helps filter out many impurities. However, groundwater can still be polluted by pesticides, chemicals, fertilisers, and other materials that may seep into groundwater supplies.

Experiment 1: Liquid water to water vapour and back again.
(Teacher demonstration)

Materials:

- A transparent kettle
- Water
- A container, e.g. glass or cup
- A large spoon
- Oven gloves for holding the spoon

Method:

1. Boil the kettle. As water boils, steam escapes through the spout. It forms as water vapour as it meets the cold air outside. Tiny drops of liquid water condense from the vapour and join together until they are big enough for you to see as clouds of steam.
2. Hold a large, cold spoon in the path of the steam. The water vapour condenses and drips off the spoon into the glass or cup.

Explain to the class that this experiment shows how the processes of evaporation and condensation occur.

Experiment 2: Water Vapour to Liquid.

Materials:

- A drinking glass
- Water
- Ice cubes

Method:

1. Fill a dry glass with ice cubes and water.
2. Leave for about 15 minutes.
3. Look at the outside of the glass.
4. Run your finger over the outside of the glass. What do you feel?

Explain to the class that the tiny drops on the outside of the glass are water that has condensed from the air. Some of the water vapour in the air changed to liquid when it touched the cold glass.

Q. Ask the class if they have ever noticed condensation at home.
(e.g. Windows in the morning after a frosty night, or on the bathroom mirror after a shower if the window isn't open).

Experiment 3: Water Cycle

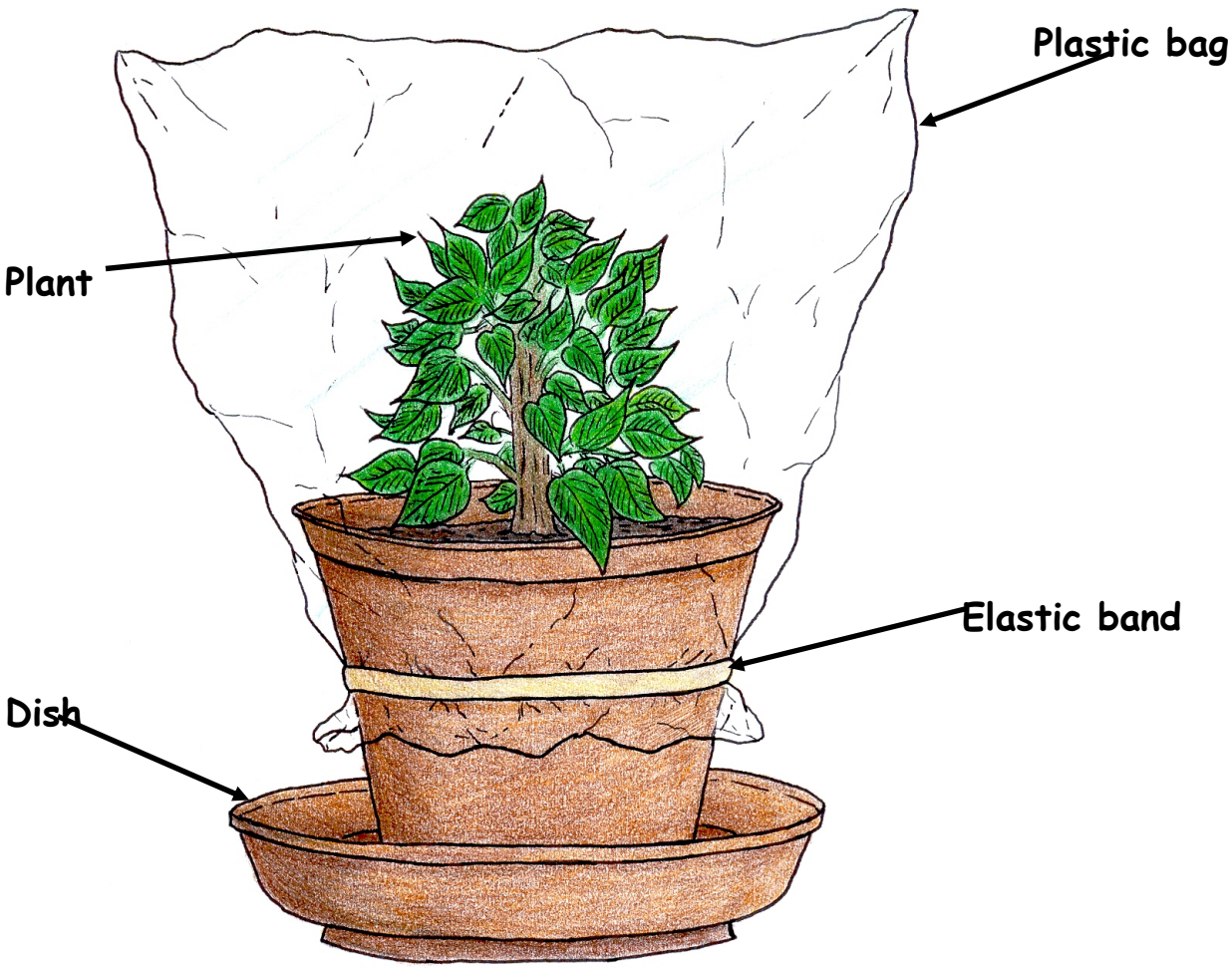
Materials

- Potted plant
- Plastic bag (see through)
- String/elastic band
- Dish

Method

1. Make sure the potted plant is well watered before the experiment!
2. Place the plant in the dish.
3. Place the plastic bag over the plant.
4. Secure the bag with the elastic band/string, around the pot.
5. Leave in a sunny place!

After a time (less than an hour) notice the water drops on the inside of the plastic bag! This water has evaporated from the leaves and soil and has condensed on the plastic bag.
This shows how water evaporates from the earth and condenses in the clouds!



Explain to the class that the water cycle is powered by the sun and gravity. The sun kick-starts the whole cycle by heating all the Earth's water and making it evaporate.

Gravity makes the moisture fall back to Earth.

The Earth's gravity is what keeps you on the ground and causes objects to fall. The Earth tries to pull everything down towards its centre. This pull is called the force of gravity (the invisible force). When you lift things up you have to pull against gravity. If you drop a pencil, gravity pulls it to Earth.

Where does water go?

Nearly all of the water in the world goes into the seas and oceans. This is salty water. Most of the rest of the water is trapped in the Northern and Southern ice caps, known as the Arctic and Antarctic regions. The little

that's left is in our rivers and lakes and under the ground. This is called freshwater and it is what we mostly use for drinking, cooking, flushing our toilets, brushing our teeth, etc. When we are finished with it, the water goes down through pipes and into the rivers and the lakes and from there eventually into the sea.

Humans need freshwater to survive, but approximately 97% of the Earth's water is too salty to use. The remaining 3% is freshwater, but most of it is in polar ice-caps, remote glaciers, and icebergs, and is not easily accessible. Accessible freshwater, therefore, comes from surface water and groundwater sources. These sources represent less than one half of one percent of all water on the earth.

Activity: To show the amount of salt and fresh water on the planet.

Materials

- 1000ml graduated cylinder (or 1litre container)
- 5 x 100ml graduated cylinders (or small jars)
- Medicine dropper
- Food colouring

Earth's Total Water Supply

972ml Ocean (salt water)
28ml Fresh water
1000ml Total

Earth's Total Fresh Water

23ml Icecaps and Glaciers
4ml Groundwater
2 drops* Surface Water
1 drop* Water in Air and Soil
28ml Total

* 3 drops= 1ml

Method

Display the above values in chart form for the class. Discuss this with the students and tell them that you are going to show them what these proportions look like.

1. Place all the materials on a table in front of the class.

2. Fill the large graduated cylinder with coloured water to the 1,000ml line. Tell the class that this represents the Earth's entire supply of water. Pour 28ml of this into a second cylinder. This represents the Earth's total fresh water supply. The remaining 972ml of water is salt water that occurs primarily in oceans and seas.
3. Divide the 28ml of fresh water by pouring portions of it into smaller containers: 23ml for icecaps and glaciers, 4ml for groundwater, 2 drops for surface water, and 1 drop for the water in the atmosphere and soil.

Lesson 3: Don't waste it!

Lesson Objectives:
To learn about the importance of water conservation.

Lesson Plan:
- Discussion: What is drought?
- Reducing water wastage.
- How to read a water meter.
- How do we use water?
- Activity: "Baile an Uisce": Ways to conserve water.
- Discussion: Climate change in Ireland.

Materials Required:
- A measure vessel (e.g. 5 litre jug)
- Watch/timer

In Lesson 2 the pupils learned that although there are vast oceans of water in the world, only a small amount of freshwater can be used to quench our thirst (and only when it has been treated to remove harmful bugs). Even so, we waste so much drinking water every day.

Explain to the class that because we have loads of rain in Ireland, you might think that we don't need to conserve water. But, just a few weeks of dry weather can cause rivers and lakes and underground water supplies to dry up. Emphasise the fact that we should never, never take a water source for granted.

Discussion: What is drought?
The meaning of the term 'drought' is not quite as clear-cut as 'having no rainfall'. A simple definition of drought would be: when there is less rainfall than expected over an extended period of time, usually several months, or in some cases longer. Drought is a normal feature of the climate in most parts of the world, but its effects on the environment can vary from one country to another because of different geographical features and cultures, which can affect how people use their water.

Another way to think of drought is in relation to supply and demand. The water that we have available to us is that which falls as rain and is stored in our lakes and reservoirs. Some water supplies may also be obtained from underground aquifers. Humans use water for many different activities (these will be dealt with later on in the lesson). During times of drought, the amount of water available for use may be a lot less than usual, and therefore, we have to learn how we can reduce our demand for water so there is enough available to meet our basic needs until rainfall returns to normal.

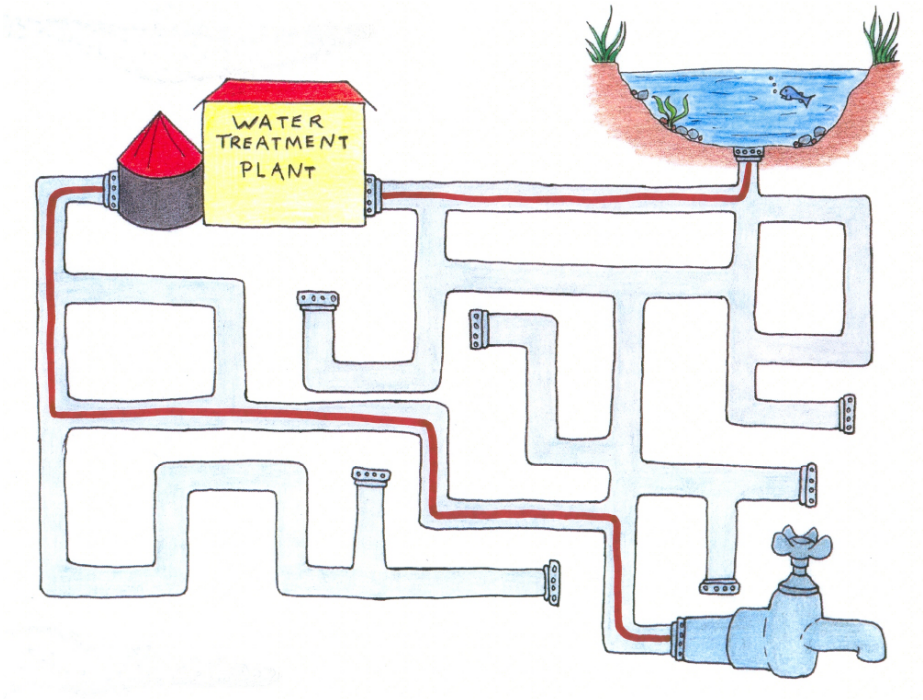
Periods of drought can have huge environmental, health, agricultural, social and economic effects. Examples of these effects include the following:

- Reduced crop yields.
- Famine due to lack of water for irrigation of crops.
- Malnutrition, dehydration and certain related diseases.
- Death of livestock.
- Shortages of water for industrial and municipal use.
- Reduced electricity production (due to reduced water flow through hydroelectric dams and insufficient available coolant for power stations).
- Mass migration, resulting in international refugees.
- War over natural resources e.g. water and food.
- Wildfires and bushfires.

Activity: Follow the water from the source to the drinking tap.

Explain to the class that it costs a lot to pipe water from its source to your tap, especially as it has to be made safe for drinking. Wasting this precious resource makes no sense at all!

Ask the children to complete the "maze activity" by following the correct water pipe from the source to the drinking tap. (Remember: the water must first be treated at the water treatment plant! There may be another pipe that goes from the lake to the tap. Explain to the class that the water in this pipe has not been treated and will contain harmful bugs and pollutants).



Once the activity has been completed, have a short discussion with the class about the source that serves the local community and about where the treatment plant is located. As the school may include pupils from a number of water scheme areas, the teacher should be prepared by contacting local water providers (group schemes and/or local authority). The Rural Water Liaison Officer in each County Council will be able to help, as will the National Federation of Group Water Schemes.

A good way to help the environment and save money is to reduce water wastage. Here are two things that the children can do to help:

1). Become a water leak detective. If you see a leaking tap or pipe, or if you spot a wet patch on the road or footpath on a very dry day, report it to your parents or teacher. Suggest that they contact a plumber or the local group water scheme.

2). Stop wasting water and encourage your family and friends to do likewise.

Discussion: The demand for water is increasing every year in Irish homes. Can you suggest any reasons for this?

This question allows for a brief discussion on why more and more water is being used in Irish homes. Amongst the reasons might be:

- We have larger houses, with several bathrooms and toilets,
- There is more attention to personal hygiene today than in the past, so people tend to shower/bath more often,
- People change their clothes more often, so the washing machine is used more frequently than ever …. etc.

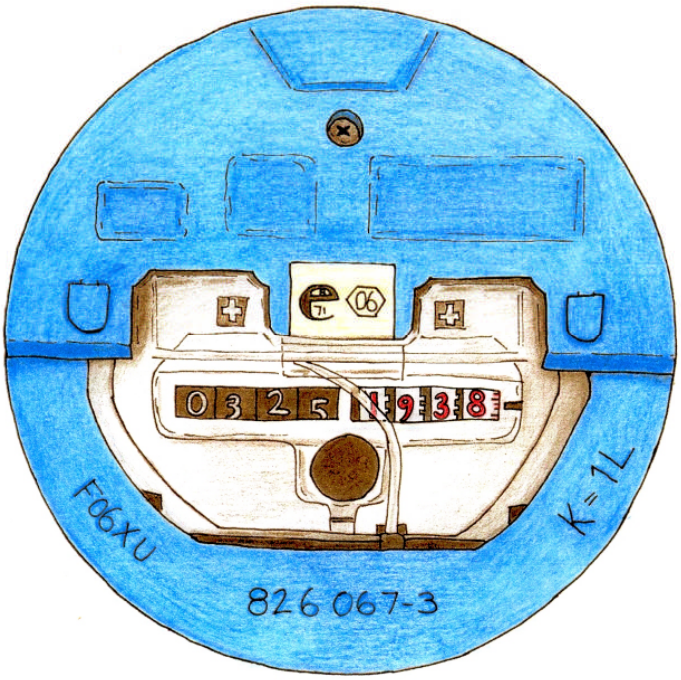
Explain to the class that there are lots of ways that we can save water. Before we look at these, we should first learn how to read a water meter, as this will tell us how much water we are saving.

Activity: How to read a water meter.

Reading a water meter is simple, but meter lids are very heavy so remind the children to always make sure that they are accompanied by an adult.

Meters can vary but most have two rows of figures. On the left, these measure thousands of litres, so hopefully these won't change very often. The figures on the right measure up to a thousand litres. Explain to the class that if there is a tap running, you will definitely see these figures change. The two rows of figures are always different colours!

Q. Ask the children if they can tell how many litres of water have been measured on the meter below?



Answer: (to the nearest litre) 325,193 litres.

At the end of the lesson, the children may be invited to examine the schools water meter (having first turned off all water appliances). Each pupil may be asked to check that the meter isn't turning and may be asked to read it, writing down what they think the reading is. If the dial is still turning, there must be a problem. Sometimes the leak is easily found, as the pipe is visible or it is a tap that just doesn't turn off properly. But remember, leaks might also occur underground!

Once each pupil has examined the meter, tell them what the actual reading is and suggest that they read the meter again at the same time the next day to get an idea of how much water the school is using. Remember, care should be taken when removing and replacing the water meter lid!

Activity: Do the sums!

Even a small leak can lose a lot of water over time. Let's see how much:

1. A leak of just one drop per second loses 4.26 litres per day. If a tap is leaking one drop per second, how much water will be wasted in a year?
2. A leak of two drops per second loses 13.88 litres per day. If a tap leaks two drops per second, how much water will be wasted in November?
3. Drops breaking into a stream lose 90.84 litres per day. If a tap is leaking drops that are breaking into a stream, how much water will it waste in just one week?

Q. Ask the children to calculate how much water is lost in each of the above cases.

Answers: **1.** 1554.9 litres **2.** 416.4 litres **3.** 635.88 litres

Experiment: Water Wastage!

Materials:

- A measure vessel (e.g. 5 litre jug)
- Watch/timer

Method:

1. Place the measuring jug under a tap.
2. Turn the tap on so that a small stream is flowing from it.
3. Time the stream for 15 minutes.
4. Measure the amount of water left in the jug.
5. Ask the pupils to work out the amount of water wasted in an hour, a day, a week and a year. They then might be able to calculate these losses at the cost of bottled water (e.g. €1.20 per litre).

Remember! Don't waste the water used in the above experiment! Use it for watering the plants etc!

Activity: How do we use water?

Q. Ask the pupils if they know where water goes in their homes and what household activities use the largest amounts of water? Below are ten activities that require water.
Match the figure to the use, with the highest daily user at number 1 and so on:

Drinking, including diluted orange, tea and coffee ☐
Taking an ordinary shower ☐
Taking a power shower ☐
Cleaning the house and washing floors/windows ☐
Flushing the toilet ☐
Washing clothes ☐
Enjoying a soak in the bath ☐
Brushing teeth ☐
Washing hands ☐

Cooking

The pupils should be allowed 2-3 minutes to think about and complete the task. The class might then be divided into teams, each team being formed by those who rated the same item at number 1. After allowing a short discussion within each team, a spokesperson should be asked to justify their selection. The objective is to get the class thinking about water use, so that they might be allowed to desert their team for another one (or to form an entirely new team with a new first choice), if they feel they were mistaken originally. However, they should be asked to justify their new choice!

Of course, there is no 'right' answer to what uses the most water in the home. It all depends on how we use it. Even so, we can rank use based on more information. If we do this, we find that most water (by far) is used in the bathroom. Our table should look something like this:

1. A power shower uses **90 litres** in 5 minutes.
2. A bath uses about **70 litres**.
3. A toilet flushed 7 times a day uses **56 litres**.
4. A washing machine (new model) uses **50 litres**.
5. Washing hands (with tap running for 1 minute) 7 times a day uses **42 litres**.
6. Brushing teeth (tap running for 3 minutes) twice a day uses **36 litres**.
7. An ordinary shower uses **35 litres** in 5 minutes.
8. Washing dishes in the sink (3 times a day) uses **30 litres**.
9. Cleaning the house and washing floors/windows uses **16 litres**.
10. Drinking, including diluted orange, tea and coffee uses about **4 litres**.

Before we start thinking about ways of saving water in the home, it is worth looking outside at other areas where water is used.

- Watering plants and lawns.
- Washing a car with a hose.
- Water features in the garden, such as fountains, ponds and even swimming pools.

Such use of water outdoors can far exceed normal use in the home.

Activity: Baile an Uisce: Ways to conserve water.

Uh oh! The villagers of Baile an Uisce are in big trouble! The precious source that provides their drinking water can no longer be used, so that when taps are turned on, nothing comes out! Bottled water is far too expensive. Unless something is done quickly, they'll have to change the name of their village to Baile *gan* Uisce!! (The town is called Baile an Uisce, or 'Ballinisk', because of its very good water, thus 'Water Town'. Of course, Baile gan Uisce would mean 'Town without water').

Most rivers, lakes and wells in the area can't be used for drinking. However, one small nearby lake has fresh clean water that is easily treated. BUT, this source will only last for one month if everyone uses as much water as usual. What can the people of Baile an Uisce do to help conserve their water supply?

Divide the class up into teams, each team writing down 5 things they would do to reduce water wastage in the community. Again, co-ordinate a debate as to which measures would have greatest effect (some of the answers are on the following page). The discussion is designed to inform the pupils that they can make a difference, both in how they conserve water themselves and in how they might encourage water conservation by other family members.

Check if the children have included the following ways to conserve water:

1. Check for leaks and have them fixed!

2. No power showers and no baths (unless it is shared with your brothers and sisters). Ordinary showers only, turning it off while washing your hair and applying conditioner. And be quick about it!

3. No leaving the tap on while brushing teeth or washing your face….. wet the brush/face cloth, then turn off the tap until rinsing.

4. Don't flush as much…'if it's yellow, let it mellow, if it's brown, flush it down!'…. and use a plastic litre bottle or a 'Happy Hippo' in the toilet cistern to reduce the amount of water used in each flush.

5. Don't leave taps running in the kitchen either. Use a basin or bowl for washing dishes or fill up the dishwasher if it's modern.

6. Also use a basin for washing vegetables and when cleaning about the house.

7. Make sure the washing machine has a full load each time.

8. Keep a jug of water in the fridge, so that you don't have to run the tap to have a cold drink.

9. In the garden, the use of hoses and water features that demand freshwater are banned … use the waste water from washing dishes/vegetables and even from showers etc. This is the only water that should be used in the garden during a drought, unless your family has been smart enough to catch rainwater in a water butt.

10. Don't cut lawns too short. By leaving the grass a little longer, morning dew is trapped and evaporation is reduced. Using a mulch also reduces evaporation and lowers water demand.

11. Use watering cans, but only during the coolest part of the day.

12. If the car has to be washed, then use a bucket filled with the wastewater from your sink or shower.

Discussion: Climate Change in Ireland.
The class might discuss what climate change will mean for Ireland.

First explain to the class what 'climate' is. **A simple definition for climate is our average weather over a long period of time. 'Climate change' is a considerable change in the average weather that we experience.** The term climate change is usually used in reference to changes in our climate caused by the build up of 'greenhouse gases' in the atmosphere.

The Earth is surrounded by a layer of gases which keep us warm by trapping energy (heat) from the sun (hence the term 'greenhouse' gases). The problem is that people and industry produce more of these gases than they should, which makes the layer thicker than it should be. This thicker layer means that more heat is trapped and therefore the Earth is warmed more than it's suppose to be. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Certain human activities such as burning fossil fuels for energy, transport and heating, can cause a build up of these gases.

Climate change has already begun to affect us in Ireland, just think of the increases in rain, storms and floods in recent years! If we don't do something to stop climate change then Ireland, along with the rest of the world, will experience even more changes in climate, e.g. higher temperatures, unpredictable storm events and higher sea levels. The effects of climate change are not consistent, i.e. some countries will suffer more than others, (e.g. drought, disease etc), while other countries may benefit (e.g. warmer winters). In Ireland, our winters will be warmer and wetter – by 2050 the average temperature in January will increase by about 1.5 degrees Celsius. Average rainfall is also set to increase by about 11%! Our summers will be warmer and drier – by 2050 the average temperature in July may increase by 2.5 degrees Celsius! We will also have summer droughts which will result in competition for water supplies.

Impacts of Climate Change in Ireland:

- Increase in flooding (especially along the west coast of the country).
- Lower crop yields (farmers will be unable to grow potatoes).
- Droughts during the summer.
- New diseases and agricultural pests may appear.
- Increased water pollution problems.
- Problems for water supply infrastructure may also occur.

What can you do?

If you use the energy saving tips below you can help combat climate change!

- Turn off your TV completely when you are not using it, don't just leave it on stand-by.

- Switch off the lights when you leave a room and use energy efficient light bulbs instead of traditional light bulbs.
- For short journeys try to walk or cycle instead of taking the car.
- Turn the heating down in your house (by reducing your thermostat by 1 degree Celsius you could save 10% on your heating bill!).
- Fit a lagging jacket on your hot water cylinder.
- When boiling the kettle, don't overfill it. Only use the amount of water that you need.
- Support renewable energy initiative in your community, e.g. solar and wind power.
- Make sure to re-use and recycle as much and as often as you can.

For more information on climate change in Ireland see the following websites:

- www.combat**climatechange**.ie
- www.**change**.ie
- www.environ.ie/en/PublicationsDocuments/FileDownLoad,1861,en.pdf (Irelands National Climate Change Strategy 2007-2012).
- http://globalwarming.house.gov/impactzones/ireland

Homework:

Ask your grandparents or elderly neighbour if they remember how they collected water for use in the home and for drinking when they were your age. Relate their stories to the rest of the class.

Lesson 4: Pollution pollution! Can you find a solution?

Lesson Objectives:
To learn what water pollution is, where it comes from, and how to prevent it.

Lesson Plan:
- What is water pollution?
- Examples of different pollutants.
- Experiment: Oscar's River Journey.
- How can you help prevent water pollution?

Materials Required:
- 1 large clear water container
- 10 plastic jars
- Baking powder
- Muddy water
- Vegetable oil
- Fishing line/string
- Sweet wrappers, plastic etc
- Yellow food colouring
- Tissue paper
- Vinegar
- Soapy water

Explain to the class that today they are going to become environmental warriors and prevent water pollution! But first they need to learn what water pollution is and where pollutants come from.

What is water pollution?
Pollution is anything that harms the natural environment, whether it is air, soil, or in this case, water. Sometimes the pollutant is something you can see in the water. Other times you can't see the pollution at all.

Q. Ask the class if they can name 3 things that might pollute water?
(e.g. oil, human and animal waste, rubbish, household chemicals…)

Aquatic life is everything that lives in water. It includes some mammals, as well as fish, tadpoles and tiny insects, and the plants that they rely on for food. Remember, water is healthy when it is clean and supports aquatic life. When rivers and lakes get dirty, aquatic life becomes sick and can even die. Explain to the class that water is healthy when it is clean and can support aquatic life, especially fish. When rivers and lakes get very dirty, fish can become sick and even die.
Apart from the damage to aquatic life, pollution can harm human health too. That is why water needs treatment before we can drink it. The more polluted the water, the more treatment is needed.

Q. Ask the class if there are any polluted streams or rivers where they live?

Different Pollutants:

Sewage
Human and animal poo is very harmful to water. We flush it down the toilet and off it goes. Unless we are careful, it will run into our streams, rivers and lakes! In towns and cities there are special treatment plants for poo. In the countryside, most families rely on
septic tanks. All of these systems need to be working properly.

Remember, sewage has dangerous bacteria that can spread diseases to plants, animals and humans. Polluted water can cause tummy upset, diarrhea and vomiting. In some countries it causes cholera, malaria, and blindness in children. It also kills people. In fact, somewhere in the world, a child dies every 15 seconds because of sewage in their drinking water supply and lack of water treatment.

Lakes and beaches are often closed to swimmers and fishermen because of high counts of fecal coliform bacteria from human waste and feedlot runoff that makes its way into rivers and streams then empties into the lakes and oceans. Although coliform bacteria are not harmful themselves, they usually indicate that pathogens, disease causing
organisms, are present.

Sediment
The soil and rocks that can be eroded and washed away by a river is called sediment. You may think that this dirt in the water would not cause any

harm. In fact sediment deposits help farmland, providing nutrients for crops. However, too much of it can clog up fishes gills so that they can't breath. It reduces the amount of sunlight available to plants to make their food and it decreases visibility for fish and animals that live in water, such as otters. These changes can have terrible effects on aquatic life.

Chemicals

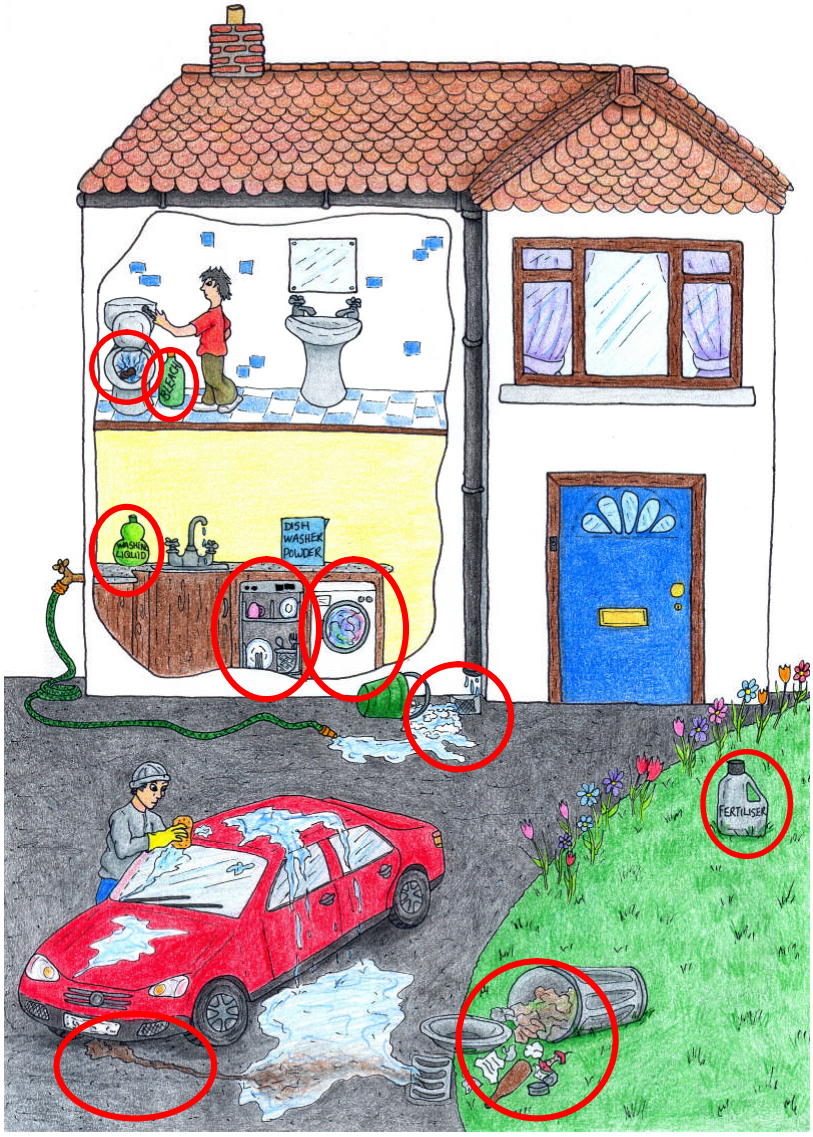
Chemicals such as oil, detergents, pesticides and fertilisers can harm the animals, bugs and plants that live in water and can make people sick. These things should never be flushed down a sink or storm drain. Nor should they be spread close to water.

Why not? Well, when it rains, surface runoff carries the chemicals from houses, farms, lawns and roads into nearby streams and rivers. A lot of chemicals (such as nitrogen or phosphorus) will cause plants called algae to grow in water. Algae may be tiny plants but they grow very quickly and can form a green slime in our lakes. This happens most during hot weather when we want to swim in those lakes. Some algae are poisonous to humans as well as other aquatic life. Algae don't live long but even as they die and decompose they use up lots of oxygen, leaving very little for the rest of the aquatic life. With less oxygen, they suffocate and may even die.

Litter

Litter is another type of pollution that can harm the environment. Rubbish such as plastic bags, cans and sweet wrappers get swept away by rainwater. When they are washed into storm drains, they end up floating in our lakes and rivers. Besides being ugly to look at, litter can affect the health of water and damage aquatic life. Drinking-can holders are especially dangerous. Plastic takes hundreds of years to break down and become harmless to the environment.

Activity: Can you spot all of the pollutants in the picture below?



Answer: **a)** poo being flushed down the toilet, **b)** bleach, **c)** washing-up liquid, **d)** dirty water from dish washer, **e)** dirty water from washing machine, **f)** soapy water from washing the car, **g)** oil leaking from the car, **h)** litter, **i)** fertiliser.

Farming Activities

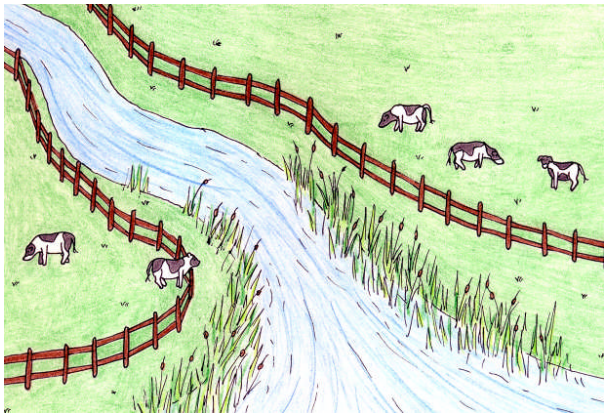
In Ireland, one cause of water pollution is when cattle graze too close to a river or stream. They trample the river banks and sometimes even use the river as a toilet! Yuck! As you learned earlier, animal waste and sediment are big water pollutants. Fencing off rivers and streams is a good way to prevent

this type of pollution as they keep the cows, and other farmyard animals, out of the water.

Other farming activities like the use of fertilisers and the spreading of slurry (a mix of animal pee and poo!) may also cause water pollution. It is very important not to spray fertilisers too close to a river, especially on a rainy day. This is because the rain helps wash the fertilisers into any nearby waterbodies. Farmyard slurry or manure, should only be spread when it is warm enough for things to grow and when there is no rain forecast.

Activity: Spot the difference.

Q. Ask the class to try and spot the differences between the two drawings.



Answer: In **Picture 1**, the cows have trampled the river banks, causing them to become unstable. This in turn results in the erosion of the banks. **A simple definition for erosion is: when pieces of rock, mud, sand etc are broken down or worn away (e.g. by the force of a river) and are carried to another place.** Some of the cows in the picture are standing in the river. As discussed above, animal waste is very harmful to water and so fencing off any access to river banks, removes any direct inputs of manure and decreases the amount of damage caused by erosion.

In **Picture 2** the river banks have been fenced off and therefore the cows have no access to the river. The banks are now more stable because natural vegetation has grown in this area. Plants and their roots help to hold the mud and clay together, decreasing the amount of erosion. They give cover to fish and other wildlife (thereby increasing the biodiversity of the river). The

vegetation also creates a river corridor or a '**buffer zone**' that can help to soak up excess nutrients caused by pollution.

A buffer zone is a strip of natural vegetation approximately 1-5metres wide that occurs alongside waterbodies, particularly small rivers and streams. They may be used to move certain agricultural operations e.g. livestock and machinery movements, away from river banks, therefore decreasing the potential for direct pollution. Some examples of this may be: the prevention of sprays and fertilisers entering the river directly; preventing livestock polluting the water through urine/faeces and disturbing the river sediment; or pollution from tree felling in forestry.

There are no definitive guidelines as to the width of these buffer zones, but in practical terms they should be at least as wide as the longest spray boom that is likely to be used when fertilising crops etc. In terms of livestock, 1m is usually considered to be wide enough, since the objective is to prevent cattle form disturbing the river banks.

Along with reducing nutrient levels (Phosphates and Nitrates) caused by pesticides, fertilisers and animal wastes, buffer zones help to restore habitats. This has huge beneficial effects on biodiversity.

The sources of pollutants that cause water pollution vary. For example, pollutants may come from a pipe discharging into a river, a boat, a septic tank, or another single source. This is known as a "point source" of pollution. But frequently they are varied sources, collectively called a "nonpoint source." These may include industries, agriculture, and other human activities.

Point source problems are the easiest type to correct. Their causes can be dealt with directly. Additional treatment may be required, or other measures can be used to prevent water quality problems.
Nonpoint source problems are more difficult to fix. They result when rain from your lawn, roads, car parks, and farms, runs off into rivers and streams. This runoff may contain oil, fertilisers, pesticides, bacteria, and other substances that can affect water quality. Another type of nonpoint source pollution is erosion of soil from farmlands, construction sites, and stream banks. Fixing nonpoint source problems requires a great deal of

cooperation. We must all take better care of the land to reduce nonpoint source pollution.

Did you know?

Do you know the difference between a 'storm drain' and a 'sewer'? Storm drains collect surface water and carry it, untreated, directly to rivers and streams. Sewers collect water from inside homes and carry it to treatment plants, before it is released to our rivers and streams. SO REMEMBER, only rain water should go into storm drains.

Activity: Oscar's River Journey.

This activity deals with the pollution of water bodies. Explain to the class that everyone lives in a catchment area and contributes either directly or indirectly to the degradation of our streams, rivers and lakes. We often don't even realise how much damage we can do!

Sit the pupils around a large, clear container. Divide the class into small groups, each group taking charge of one jar (see the "pollutants table" below stating the proposed contents for each jar). Read the story of Oscar's river journey aloud, stopping when different land uses are mentioned so that the pupils can empty their jars into the water on cue. After the story, ask the class how they feel about the water now? Would they like to drink it? Or swim in it? Discuss how they would feel if their local river or stream got polluted? How could they help to prevent this from happening?

Materials:

- 1 large clear water container
- 10 plastic jars
- "Pollutants" (see table on next page)

Pollutants

Jar No.	Land Use/Activity	Substance
Jar 1	Farm land	Baking powder (fertiliser) (Teaspoon)
Jar 2	Herd of cattle	Thick muddy water
Jar 3	Grazing land	Salty water (teaspoon salt in jar of water)
Jar 4	Boating activities	Vegetable oil (couple of tablespoons in jar of water)
Jar 5	Fishing	Fishing line/string
Jar 6	Park	Sweet wrappers, plastic etc
Jar 7	Gardens	Baking powder (pesticides) (Teaspoon)
Jar 8	Septic Tanks	Yellow food colouring (a few drops in a jar of water) and small pieces of tissue paper
Jar 9	Roads	Vinegar (petrol)
Jar 10	Industry	Soapy water (detergent)

Method:

1. Fill each jar as described above.
2. Give each jar to each group of children (tell the class not to open their jars until their land use is mentioned in the story).
3. Place a clear plastic container half full of water in the middle of the room.
4. Read the story aloud, stopping at each land use/activity (highlighted in red) so that the pupils can empty their "pollutants" into the water.

Oscar's River Journey.

One sunny morning, Oscar was very bored. He was tired of swimming in the little stream high up in the mountains and decided that this would be the day that he would explore the whole river!

The stream gushes down through the hills and valleys, and Oscar has great fun chasing all the fish that he meets along the way. The water soon begins

to flow through farmland where some crops have recently been fertilised. They have just been watered by a heavy fall of rain which has washed some of the fertiliser into the stream **(Jar 1)**.

On the other side of the stream, Oscar sees a herd of cattle eating the grass along the banks. Some of them are standing in the stream having a drink. The bank is trampled and has collapsed into the water under the weight of the cows **(Jar 2)**.

There are very few trees left in the field. In some parts the watertable had risen because there are not enough trees left to soak up all the water. This water brings all of the salts in the soil up to the surface where they are washed into the stream **(Jar 3)**. Oscar can taste the salty water as he swims alongside the bank. It does not taste very good so he decides to swim as fast as he can to get away from it!

Oscar soon begins to notice that the stream had slowed down. It has also become wider and deeper! As he turns around a bend he sees some people on a motor boat. He dives under the water so that they can't see him. But UH OH! The boat is leaking oil into the river **(Jar 4)**!

There is a man fishing in the boat. Unfortunately his line gets caught around a rock and it gets left behind **(Jar 5)**.
On the river bank, Oscar sees a family having a picnic under a tree. They are playing and having fun, but all of a sudden, a gust of wind blows all of their rubbish into the river **(Jar 6)**! Poor Oscar nearly chokes on a plastic wrapper!

The river slowly enters a small town. There are a few houses with beautiful gardens along the river bank. Oscars notices a woman using some pesticides to keep the nasty bugs away from her plants. She then turns on the sprinklers to water all the flowers, but this means that the poisonous pesticides get washed into the river **(Jar 7)**!

Some of the houses in the town are not connected to a major sewerage system. Instead they have their own septic tanks. Sometimes these septic tanks are not looked after properly and can overflow. This means that untreated waste can seep into the river **(Jar 8)**! YUCK!

Oscar swims pass the houses and into the centre of the town where there are lots of roads and motorways. There are also lots of cars which can sometimes leak oil and petrol onto the roads. These pollutants can get washed into the stormwater drains and straight into the river **(Jar 9)**!

On the other side of the town, Oscar sees a big factory. The people who work there use chemicals to keep the machinery and equipment clean. But these chemicals get washed out of the factory along with lots of dirty water. Like the petrol from the cars, these chemicals disappear down the stormdrains which lead straight to the river **(Jar 10)**.

Oscar doesn't really feel very well now. He knows that all of this pollution is making him sick. He is afraid and he desperately wants to go home to his beautiful, clean stream high up in the mountains. With one flick of his tail, he dives under the water and makes his way back home.

What is a catchment?

A catchment is an area of land where water from rain or snow flows downhill and drains into a body of water, such as a river, stream or lake. The catchment includes both the rivers and streams that convey the water as well as the land from which the water drains. A catchment, therefore, acts like a funnel by collecting all the water within the area and channelling it into a particular waterbody.

Q. Ask the children to look at the catchment diagram and pick out the different activities that may cause water pollution.

For example:

- Oil and litter from boating and recreational activities
- Fertilisers and pesticides from agriculture and gardening
- Waste from septic tanks
- Manure from farmyard animals
- Oil and petrol run-off from roads and vehicles
- Industrial wastes from factories

How can you help prevent water pollution?

Now that we have looked at all the ways in which water can become polluted, let's see how we can help keep it clean.

- **Never** flush anything down the toilet that isn't suppose to be flushed.
- Pick up pet poo – it's the law! Never leave pet poo on the footpath or ground where it might wash into gutters and down storm drains. Use doggy bags to put it in the bin.
- Start building a compost heap and encourage your parents to use it. You can compost everything from food peelings, to teabags, paper, grass and even wooly jumpers.
- Don't wash your parents' car in the driveway. If you do, harmful chemicals might end up in the drains and flow into rivers and lakes. Ask your parents to drive it onto the lawn or onto a gravel drive. That way the soapy water will soak into the ground and the soil will help filter out the pollutants!
- If you see your parents' car leaking oil, ask them to get it fixed!
- Throw your rubbish into the bin, not onto the street.
- Reduce, reuse and recycle waste whenever you can!

Lesson 5: Ooh Bugs!

Lesson Objectives:
To learn about the different insects that live in our streams and rivers, and how they can tell us how healthy, or polluted, our water is.

Lesson Plan:

- Excellent, moderate and poor streams.
- Insect classification.
- Activity: Use the insect key to identify and draw the bugs in the water sample.
- Word search and cross word.

Explain to the class that different invertebrates (insects) live in different types of water. The insects living in a stream often provide the best indicators of that stream's overall health and condition. Human activities interfere with the natural processes of a stream and can have immediate as well as long-lasting effects on the organisms that live there. We monitor insects because they represent an enormous diversity of body shapes, survival strategies, and adaptations. Many of them need cool, clear water, an adequate oxygen supply, steady flows, and a constant source of food in order to complete their life cycles. These animals, in turn, provide food for other animals e.g. fish (trout, salmon etc) and birds (herons, kingfishers etc). Below are descriptions of the insects you might find at an excellent stream site (i.e., a stream unchanged by humans, i.e. unpolluted), a moderate stream, and a poor (i.e., degraded, or polluted) stream.

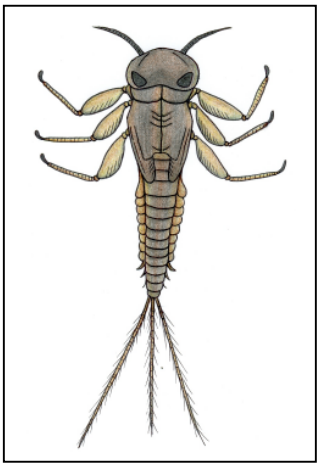
Excellent stream site:
Here we find many different types of organisms with very different body shapes and survival strategies. High biodiversity indicates a stream with low human influence (unpolluted): most of the animals featured below should be present in a water sample. Several different types of caddisflies, stoneflies, mayflies, and indicate a healthy stream. More than one type of riffle beetle may also be identifiable; some are longer and skinnier than others. Some caddisflies are tolerant of pollution, so a large number of caddisflies does not necessarily indicate good water conditions.

Moderate stream site:
The total number of different types of insects declines as water quality increases. About half to two-thirds the number of species found in an excellent stream are found in a moderate stream. The main difference from an excellent site is that there will be many fewer types of stoneflies. Mayflies should be present, but probably fewer types. Several types of caddisflies may be present depending on the type of pollution. The relative proportions of soft-bodied worms or amphipods may increase. Beetles may still be present but molluscs are not.

Poor stream site:
The total number of species types will be quite low. Most of the insects found are of the soft-bodied variety, e.g., fly larvae and worms (oligochaetes, nematodes). In very poor streams leeches and planaria may be found. Worms can be difficult to distinguish from each other due to the fact that their body shapes are similarly adapted to living in soft sediments. Stoneflies will not be present. Caddisflies may be present, but only a few types that are tolerant to certain types of pollution. Amphipods are usually present. There may be a large quantity of a single type of insect. In general, the insects present in a poor stream site may be smaller than those found at an excellent stream site.

Invertebrate Field Key.

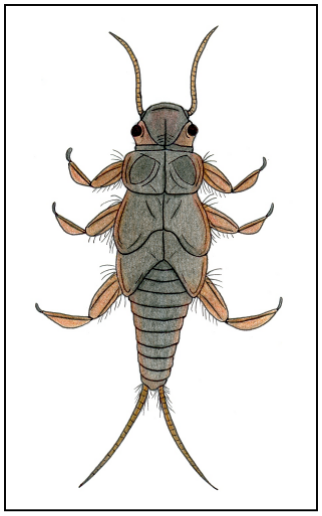
Mayfly nymphs



Mayflies are insects that spend most of their lives in streams. They emerge for a short time as adults to mate and lay their eggs. Gills are usually visible

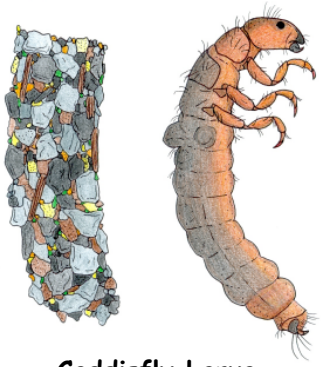
along the abdomen. If an insect has three tails it's a mayfly, (but some mayflies have two tails!). Mayfly nymphs are very strong swimmers. As young nymphs, many mayflies feed on algae (adult mayflies do not eat). The total number of species types declines as streams are degraded.

Stonefly nymphs

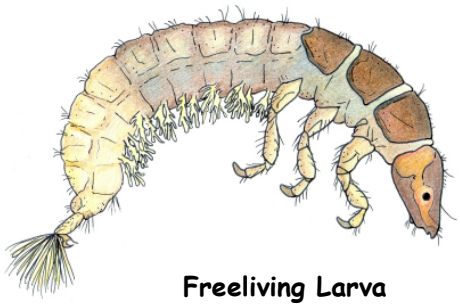


Stonefly nymphs may be found on or near stones in a stream. Adult stoneflies emerge from the water to mate and can locate each other by drumming with their abdomens. Stoneflies move like turtles and many are predators that hide between stones and cobbles to stalk their prey. They look quite similar to mayflies but are stockier. Diversity of these insects declines quickly at the first signs of human disturbance.

Caddisfly larvae



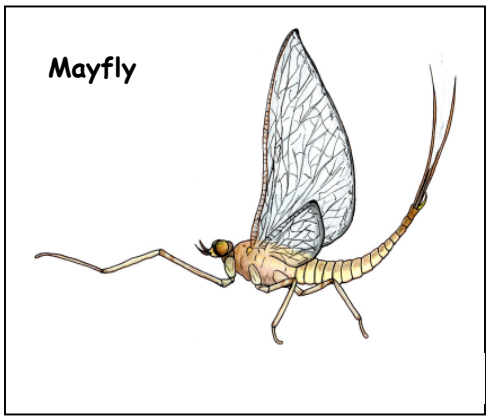
Caddisfly Larva and case

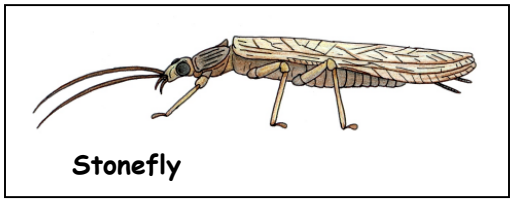


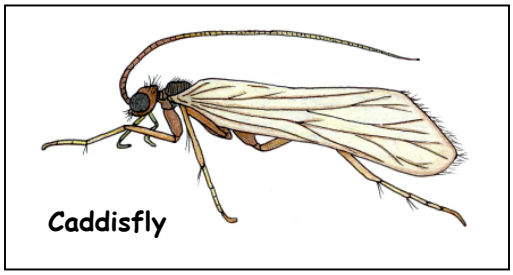
Freeliving Larva

Caddisflies, like butterflies, can use silk to build cases from twigs, gravel, or sand. Different species build different cases, which are often lost when the caddisflies are removed from a stream. They emerge as winged adults in order to mate. Caddisfly larvae can obtain their food in a number of ways: some scrape algae or shred leaf litter and others can capture their food in nets. Free-living caddisfly larvae do not build cases. Many of these are predators and therefore must move quickly in order to capture other organisms for food. Some caddisflies are sensitive to human disturbance; others are more tolerant.

Adult mayfly, stonefly, caddisfly

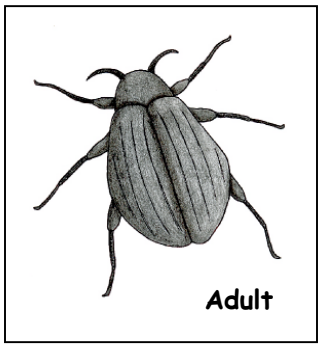


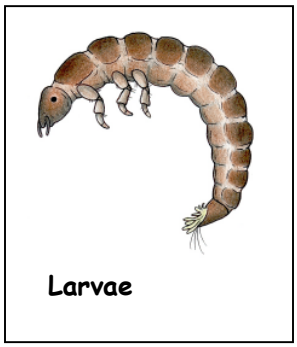




All three species leave the water to mate as winged adults. Huge swarms of mating caddisflies and mayflies can often occur when all the individuals of a single species emerge from the stream at the same time. Stoneflies are different in that they crawl out of the water and mate on the ground. The females of all three species then fly upstream and drop their eggs into the water or dive into the stream to attach them to leaves or rocks.

Riffle beetles



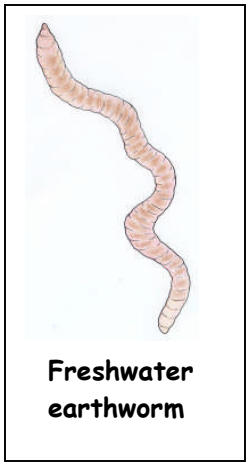


The larvae of the riffle beetle are adapted to cling to smooth rocks in areas of fast-flowing water (riffles). After the adults emerge they fly for a short time but return to the water in order to feed in the same habitat as the larvae. Both the larvae and the adults are quite small and dark-coloured. They have a tendency to drift to the bottom of a sample and so they may be difficult to find.

Aquatic Worms

Flatworm

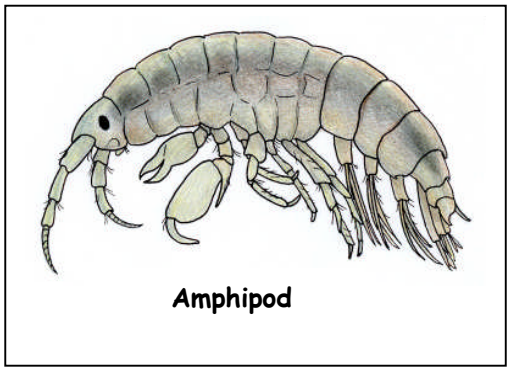
Nematode



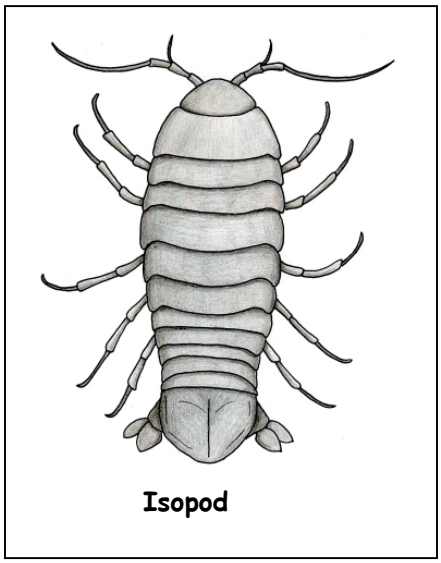
Freshwater earthworm

Flatworms (planaria), roundworms (nematodes), and freshwater earthworms (oligochaetes) are all examples of freshwater worms (not to be confused with the soft-bodied larvae of flies). Nematodes and oligochaetes have long, thin bodies and move about like snakes. These animals do not have legs.

Crustaceans



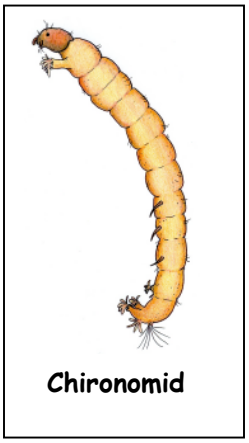
Amphipod



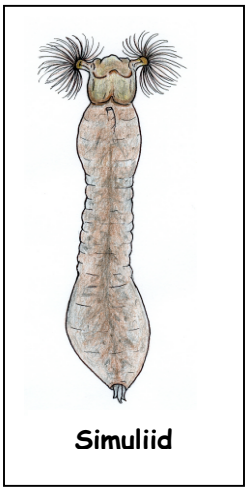
Isopod

Amphipods, usually "*Gammarus*" (freshwater shrimp), are very fast swimmers. They have many legs and their bodies look fuzzy. High proportions of these organisms may be present in moderate to very polluted stream sites. Isopods tend to be found creeping and crawling through leaf litter.

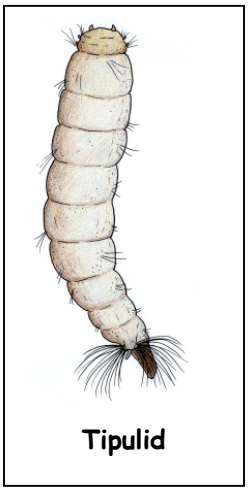
Fly larvae



Chironomid



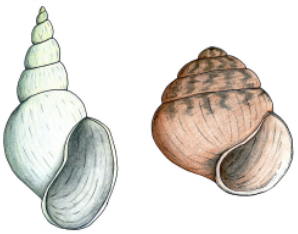
Simuliid



Tipulid

There are many species of true flies, but the main three groups are shown above. Midge larvae (chironomids) are quite small, usually "C-shaped", and have a spastic squirming movement. They are often attached to debris by their tiny legs. Black fly larvae (simuliids) are soft and often "dumb-bell shaped". They prefer to live in soft sediment and can attach themselves to the substrate. Crane fly larvae (tipulids) have large, fleshy bodies with short "tentacles" at one end.

Molluscs



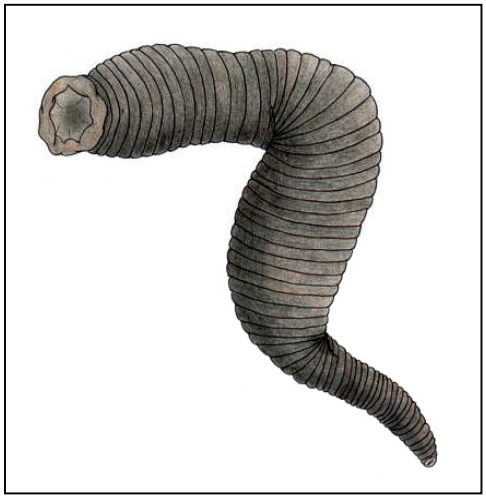
Snails

Limpets

Clam

The main groups of molluscs that can live in freshwater are snails, mussels, limpets and clams. All freshwater molluscs have hard shells. Some may cling to rocks and stones (e.g. mussels) whereas others prefer softer substrate to burrow into (e.g. types of clams). Freshwater molluscs live in many different types of wet habitats from lakes and rivers to roadside ditches and ponds. They are typically found in the shallow edges of water bodies. Here the warmer temperatures and additional light provide them with more food than is available in deeper water.

Leeches



Leeches are segmented worms and are closely related to earthworms. They have a powerful clinging sucker at each end and often feed as blood sucking parasites.

Activity: Ask the class to use the above invertebrate key to try and decide if the water sample is clean or polluted, and draw what they see.

Solution to Wordsearch.

E	I	K	X	D	U	A	N	Z	P	W	V	V	Z	I	M	T	C	M	M
Y	W	X	E	Q	N	P	G	O	A	R	U	Z	L	R	O	N	O	I	V
N	Y	C	G	C	W	M	L	T	I	U	A	N	U	G	F	A	N	V	H
N	A	E	L	C	B	I	E	U	L	T	X	H	G	C	J	T	T	L	F
Y	T	N	D	B	S	R	O	T	H	Z	U	A	A	U	H	U	A	A	W
J	K	K	X	D	L	H	N	B	L	J	M	L	R	F	C	L	M	E	I
I	Z	F	J	O	D	S	C	E	J	D	V	C	L	E	G	L	I	A	M
M	F	E	U	B	T	R	Q	G	E	G	G	A	S	O	Q	O	N	N	J
N	C	S	O	G	T	E	A	L	S	E	W	A	G	E	P	P	A	U	Q
A	E	Z	A	N	Q	T	I	G	K	C	E	I	O	A	G	Z	T	K	I
D	L	X	K	H	W	A	B	P	O	S	A	G	R	V	K	A	I	Y	S
T	B	O	Q	C	T	W	G	U	I	N	A	Z	P	Y	E	Q	O	G	F
C	H	L	J	T	N	H	R	D	V	K	F	V	U	X	Q	A	N	L	M
S	T	T	A	R	X	S	F	O	A	Z	T	L	R	Q	G	L	Z	J	V
G	I	R	I	D	A	E	F	M	P	B	H	V	Y	D	Y	G	I	P	X
R	L	M	W	B	O	R	K	Q	L	W	N	D	M	N	H	A	S	N	H
Z	V	V	O	V	T	F	Y	S	C	Y	Q	I	R	R	Y	E	T	X	H
C	A	D	D	I	S	F	L	Y	L	A	R	V	A	A	O	M	U	A	E
M	N	L	L	G	S	E	D	I	C	I	T	S	E	P	I	W	P	Y	D
U	E	G	A	Q	I	E	U	I	O	S	Q	M	F	T	R	N	F	H	W

Solution to Crossword.

Across

3. Algae bloom can cause problems for water creatures when the OXYGEN level drops

4. It is important to pick up PET waste so bacteria from it do not get into the water

5. The only thing that should go down a STORM DRAIN is water because it leads to a nearby waterbody

Down

1. Water can become POLLUTED by some of the actions people do every day!

2. When FERTILISER gets into water it can cause algae bloom

5. Washing a car can cause water pollution because SOAP can end up in nearby waterbody

6. Water that runs off rooftops and over the surface of the ground is called RUNOFF.