Scottish Water
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Our bodies and water

Third and fourth level

Description of module

This module is concerned with the importance of water to the body for drinking and for hygiene. How soap works is one main focus, and the work of the kidneys is the other, so this module would sit comfortably alongside similar work in science and health.

Main experiences and outcomes

Health and wellbeing

I am developing my understanding of the human body and can use this knowledge to maintain and improve my wellbeing and health.
HWB 3-15a / HWB 4-15a

I am learning to assess and manage risk, to protect myself and others, and to reduce the potential for harm when possible.
HWB 3-16a / HWB 4-16a

Literacy and English

When I engage with others I can make a relevant contribution, ensure that everyone has an opportunity to contribute and encourage them to take account of others' points of view or alternative solutions.

I can respond in ways appropriate to my role, exploring and expanding on contributions to reflect on, clarify or adapt thinking.
LIT 4-02a

As I listen or watch, I can make notes and organise these to develop thinking, help retain and recall information, explore issues and create new texts, using my own words as appropriate.
LIT 3-05a / LIT 4-05a

I can independently select ideas and relevant information for different purposes, organise essential information or ideas and any supporting detail in a logical order, and use suitable vocabulary to communicate effectively with my audience.
LIT 3-06a / LIT 4-06a

Numeracy and mathematics

When analysing information or collecting data of my own, I can use my understanding of how bias may arise and how sample size can affect precision, to ensure that the data allows for fair conclusions to be drawn.
MTH 3-20b

I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations.
MNU 4-11a

Sciences

I have explored the structure and function of organs and organ systems and can relate this to the basic biological processes required to sustain life.
SCN 3-12a

I can explain how biological actions which take place in response to external and internal changes work to maintain stable body conditions.
SCN 4-12a

I have contributed to investigations into the different types of microorganisms and can explain how their growth can be controlled.
SCN 3-13b

Through gaining an understanding of the structure of atoms and how they join, I can begin to connect the properties of substances with their possible structures.
SCN 4-15a

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Activity 1

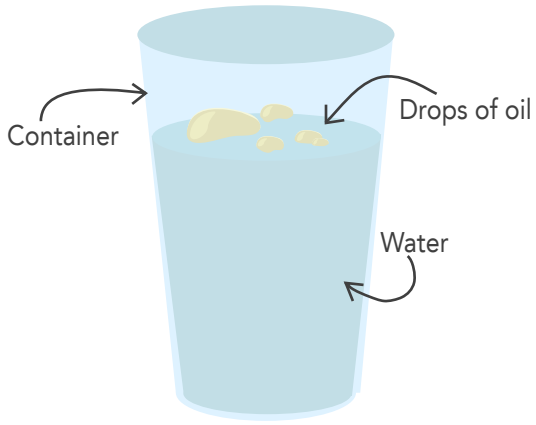
Learning intention
- Pupils develop an understanding of how soap works and how it helps to keep us clean

Success criterion
- Pupils show understanding in the formative assessment exercise: card sort or concept cartoon

Suggestions for teachers

1 Oil and water

Groups of pupils show interaction of oil and water by:
- Putting a few drops of vegetable oil (coloured) on water and observing that it does not mix
- One pupil in each group coats their hands with vegetable oil, then runs water on them. Others observe that water forms droplets on the skin, just as oil did on water. Introduce the idea that oil and water molecules repel each other and stick to their own kind. An analogy that might help here are sheep being rounded up by a sheepdog



2 Detergents

Groups of pupils show action of various detergents (for the purposes of these activities soap and shampoo are described as types of detergents) on oil-covered hands. Liquid soap, different brands of hand soap, washing-up liquid and shampoo could be used. The teacher could use a mild non-biological detergent such as Ecover to demonstrate that detergents for clothes work in much the same way (it is not recommended that pupils use detergents designed for clothes or dishwashers, in case of allergic or other reactions). Each group could include a pupil using hand soap, one with liquid soap, one with shampoo etc. and one using plain water to wash. Observations could be written up in standard form.

3 Experiments

Carry out experiments to show oil and water not mixing until a detergent of some kind is added. In the simplest form, this could consist of each group being given a jam jar and filling it one third with water with a few drops of food colouring added, and one third with vegetable oil. These form separate layers. After screwing the lids on (securely!) pupils give the jars a shake and observe what happens over the next few minutes. Half of the groups now add a small squirt of liquid soap to their jars, and all shake again, and observe. Pupils could write up experiment with words and pictures showing **before**, **during**, and **after**.

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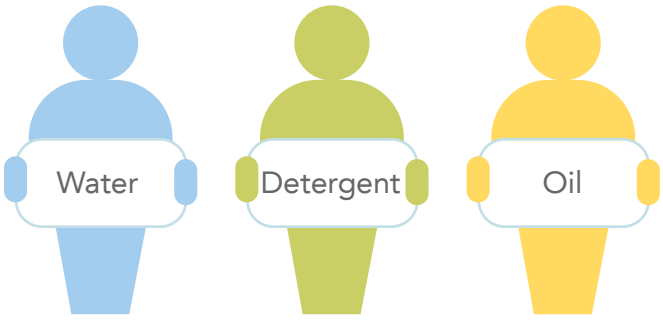
Activity 1
continued

4 Explanation

The type of explanation given for the experiment depends on the maturity level of the class. A simple visual method is to ask three pupils to come to the front of the class, and explain that one is an oil molecule and one is a water molecule, and that they don't like each other (dramatise by folding arms and turning away from each other). Now bring in the third pupil (detergent molecule), explain that they like both the oil and the water, so they link one arm with the oil and one with the water.



Relate this to the molecules bonding in the jam jars. Also relate this to how soap cleans the body: much of the dirt is combined with the natural oils that the skin produces, so just washing with water will not remove the oil and dirt.

5 Extension

A cross-curricular theme could be introduced as an extension. The Greeks and Romans used olive oil on the skin, which mixed with the body's oils - unlike water - and made it easy to scrape off with a special blade, called a strigil. This could be demonstrated with the handle of a spoon. The Greeks and Romans also bathed frequently and used perfumes; the Romans also had access to soap.

6 Resource sheet 1

The cardsort or concept cartoon activity on resource sheet 1 would serve as a formative assessment, by bringing to light any areas of misunderstanding the pupils may still have, and allowing discussion and clarification.

Examples from resource sheet 1.

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Activity 2

Learning intention
- Pupils understand how infections can spread, and the importance of water in limiting this infection

Success criterion
- Pupils contribute fully in the group feedback exercise

Suggestions for teachers

1 Resource sheets 2a and 2b

Use resource sheets 2a and 2b, which is set up for a 'chunking' exercise about hand washing. Divide pupils into fours and give each of the four a different 'chunk' of text to read. It is suggested that you allow ten minutes for this section, during which the pupils are allowed to write down five words as aides memoires. At the end of the ten minutes, each member of the group feeds back to the others what they learned from their chunk, using only their five words as prompts.

It works even better if there are five members in each group, though how the class is divided up depends on numbers, of course. The extra person acts as chairperson and timekeeper to make sure the group stays on task. Their job is also to note down the main messages, say the three most important facts the group has learned. At the end of the session, each chairperson could discuss these with the rest of the group, come to a consensus and feed these three facts back to the rest of the class as a plenary.

To take this one stage further, each chairperson could have a different remit.

- One could note the 3 most important facts
- One could note the 3 most amazing facts
- One could note the 3 most revolting facts
- One could note the 3 most mind-changing facts

Mind-changing facts are ones that will change the way the group will behave in future.

These could be collated and displayed on a suitable background, say a large hand, with the 3 facts on each finger.

2 John Snow

This is an excellent point at which to introduce the ground-breaking work of physician John Snow in 1854. By a careful survey of cholera victims in London, he pinpointed the source of the outbreak as a single water pump. The study was the founding event in the science of epidemiology, and the principles John Snow used are still relevant today. Copies of the original maps are available on the Internet; pupils could study these, or do a longer research project – Wiki is a good starting point.

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Activity 3

Learning intention
- Pupils understand how infections can spread, and the importance of water in limiting this infection

Success criterion
- Pupils show understanding of main points in producing a poster

Suggestions for teachers

1 Hand-washing posters

Show pupils hard copy examples of NHS posters about hand-washing (ones that are displayed in hospitals) and print off hand-washing posters from Google images (ones that are displayed near sinks).

2 Transmitting germs

It is easy to show how germs are transmitted from person to person using glitter. One child gets their hands well covered with glitter (aka 'germs') and shakes hands with the next person, who shakes hands with the next person and so on until no more glitter is transmitted (5 pupils?). If the first person shakes hands with 4 others, the whole class will be involved ('infected').

A low-tech way of showing the effectiveness of hand-washing is again using glitter. In this case, the class is divided into groups of four; they thoroughly cover their hands with glitter and then try to remove it, each pupil using a different method:

- One tries to remove glitter using a dry paper towel
- One uses just tap water for 15 seconds
- One uses soap and water for 15 seconds
- One uses soap and water for 30 seconds

Discussion will bring out the effectiveness of each method. Pupils will also note how much attention they paid to getting the glitter off from every part of their fingers, which will probably be very different from their normal perfunctory rub. Finally, everyone can have a good handwash using the best technique, as shown on resource sheet 3. Incidentally, singing 'Happy Birthday to You' at normal speed is about 15 seconds, so singing it twice gives about the recommended time to spend on washing hands.

3 Fluorescent lotion

The high-tech version uses a special fluorescent lotion, such as 'Glitterbug' and a UV light source: these can be bought as a 'handwashing cabinet'. This method is useful, because if pupils rub the lotion on their hands, and then wash normally, they can see which parts of their hands have not been washed properly when they hold their hands under UV. If this is not practical, there is a clip on the BBC Learning Zone called 'Bacteria and Healthy Living' which demonstrates the same thing. There are also clips called 'The Bacteria on our Hands' and 'The Bacteria Living on our Skin' which make good introductions to this topic.

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Activity 3
continued

4 Sanitation

Compare access to soap and clean running water for handwashing in the UK to some other countries, link to WaterAid to highlight importance of sanitation.
www.wateraid.org/uk

5 Bacteria

If it fits with the rest of the curriculum, this is a good point at which to introduce culturing bacteria on agar. For the purposes of these activities, swabs could be taken from pupils using each of the four washing techniques above, and a number of other surfaces suggested by the pupils. The activity could be extended to test out several types of soap, such as antibacterial and other types suggested by the pupils. As is standard practice, there should also be a control. Number, size, position, colour and shape of the bacterial colonies should be recorded carefully, and all results compared.

6 Producing posters

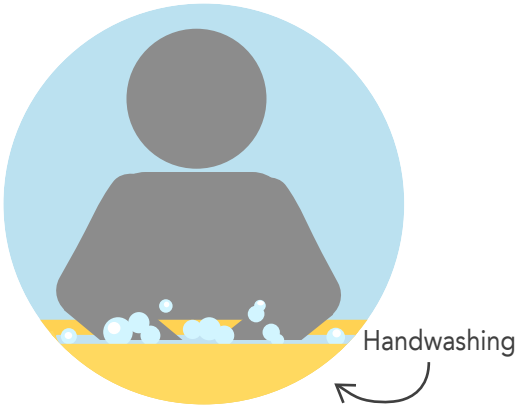
A useful assessment is for pupils to produce posters to be put up near sinks throughout the school: the messages the pupils put on these will demonstrate how much has been taken in. Posters could promote Global Handwashing Day (GHD UK), this usually falls in October. Posters could be kept on file and be pinned up across the school ahead of Global Handwashing Day, or a class competition could be organised and the winning poster could be displayed during Global Handwashing Day. https://globalhandwashing.org/global-handwashing-day/

7 Main messages

If time permits, a useful interdisciplinary or inter-departmental exercise would be to ask the pupils to produce a PowerPoint, including video clips, to illustrate the main messages. The video could include the hand-washing demonstration using glitter or UV. This could be displayed in the school. Alternatively, pages could be added to the school website.

8 Medical history

Older/more able pupils could research medical history and look at pioneers in the fields of bacteria, infection and the importance of cleanliness, such as Pasteur, Lister and Semmelweis. Their theories were doubted, and even sometimes laughed at, by other experts at the time. But their determination and commitment to discovering scientific evidence are excellent examples of how our knowledge and understanding have developed through history.



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Activity 4

Learning intention
- Pupils gain a basic understanding of kidney function, and the role water plays in maintaining health

Success criterion
- Pupils are able to use the notesheet to record the essential facts

Suggestions for teachers

1 The kidneys

Resource sheet 4a includes a basic introduction to the function of the kidneys. BBC Learning Zone has a short clip showing a dissected human kidney. These are snapshots only for the purposes of this module – obviously more detailed work is done on excretion at other points in the curriculum. The resource sheet could be shown on a whiteboard or distributed as paper copies.

2 'Chunked'

If paper copies are used, the activity could be 'chunked' as in activity 2 of this module.

3 Resource sheet 4b

The notesheet included on resource sheet 4b can be used. Pupils can also draw their own diagrams with bullet points. The description of kidney function given is very simple, and other texts - written, spoken or video - could be substituted, for example the video on Glow Science.
https://www.twigscotland.com/

4 Homework

Pupils could produce a connected text version to complete this exercise, which could be homework.

5 Urine analysis

Urine analysis is frequently done by doctors to diagnose kidney disease, diabetes or identify drug abuse. Urine analysis can also be done by pupils in the school science lab using fake urine samples. A method for making artificial urine samples is available at:
www.creative-chemistry.org.uk/activities/urine.htm

The range of tests include:
- examination by eye and nose
- protein testing
- pH testing
- glucose testing

To make this work more engaging, it can be linked to forensic science by developing a fictional crime scene investigation scenario. Pupils are tasked to identify the perpetrator of a fictional crime by analysing urine samples from several suspects.

This activity links with the role of urine analysis in medical diagnosis, drug testing and forensic investigation. The role of urine analysis in each of these areas could be explored through further research.

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Activity 5

Learning intention
- Pupils broaden their understanding of the need for water by researching a variety of topics related to the human body

Success criterion
- Pupils successfully contribute to a presentation for the rest of the class. Also see CfE outcomes below

Suggestions for teachers

This activity is aimed at pupils using their research skills, choice and initiative in order to produce a presentation for the rest of the class. By its very nature, the activity is quite open-ended and so only some general guidelines can be given here.

1 Discussion

Divide pupils into groups of 4 - 6 and discuss the task: to research a topic with the aim of producing a presentation after two school periods. The choice of topics are:

- Water for brain function
- Water for peak physical performance
- Kidney disease, dialysis and transplant
- Sweat (including use of anti-perspirants and deodorants)
- Water's journey through the body
- Hygiene
- Health benefits of swimming (could also cover importance of learning to swim, and life-saving)

2 Resource sheets 4a and 4b

Discuss the skills to be developed, and also how to make these into success criteria: how will the pupils know when they have achieved their goals?

The skills are:

When working in groups:
When listening and talking with others for different purposes, I can:
1. communicate detailed information, ideas or opinions
2. explain processes, concepts or ideas with some relevant supporting detail
3. sum up ideas, issues, findings or conclusions

When researching:
I can use notes and other types of writing to generate and develop ideas, retain and recall information, explore problems, make decisions, or create original text. I can make appropriate and responsible use of sources and acknowledge these appropriately.

By considering the type of text I am creating, I can independently select ideas and relevant information for different purposes, and organise essential information or ideas and any supporting detail in a logical order. I can use suitable vocabulary to communicate effectively with my audience.

When presenting:
I can communicate in a clear, expressive manner when engaging with others within and beyond my place of learning, and can independently select and organise appropriate resources as required.

I have used the skills I have developed in the expressive arts to contribute to a public presentation/performance

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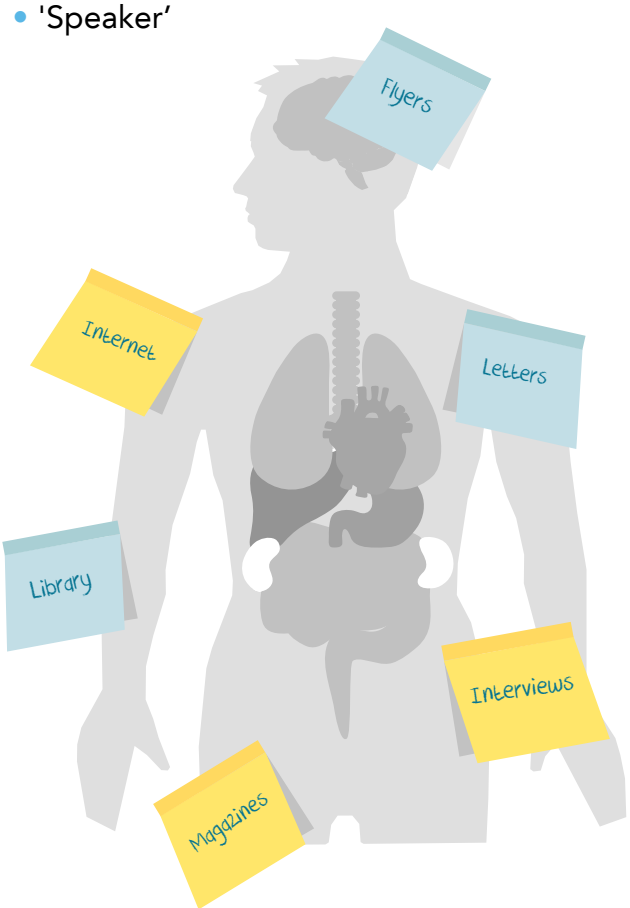
Activity 5
continued

3 Roles

Depending on how familiar the pupils are with these terms, suggest that they give specific roles to members of the group. At times, the group will all be working on similar tasks, but they may find it efficient if responsibility is given to, for example:

- 'The Keeper' - timekeeper and keeper-on-task
- 'Resources Manager' - finds, organises and keeps resources and texts safe
- 'IT consultant'
- 'Artist'
- 'Speaker'



4 Research techniques

Some suggested research techniques include:

- Using the school library
- Interviewing other pupils: surveys
- Writing to companies for information
- Using the Internet
- Newspaper and magazine articles
- Leaflets, flyers or brochures

5 Presentation methods

Some suggested presentation methods include:

- Dance
- Music (to introduce, or compose tunes or songs)
- Clips from commercially available videos
- Quiz or game for the rest of the class
- Drama: mock TV interview; puppets; dramatised events; role play
- Slideshow
- Series of posters or a flipchart
- Poetry
- Taking objects in: stuff to eat, model kidney, bottles of water, Lynx etc…and so on!

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Activity 6

Learning intention
- Pupils deepen their understanding of the need for water by researching how other animals find water and regulate its use in the body

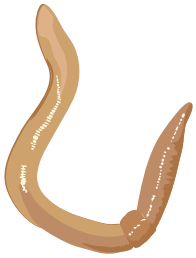
Success criterion
- Pupils successfully contribute to a presentation to the rest of the class

Suggestions for teachers

1 Research an animal

Groups of pupils choose an animal to research. Some suggestions:

- meerkats
- camels
- elephants
- garden birds
- earthworms
- gerbils
- snakes (e.g. rattlesnakes)
- dolphins



2 Answer the questions

Each group tries to find the answers to these questions:

1. Do the animals drink? If not, how do they take water into their bodies?

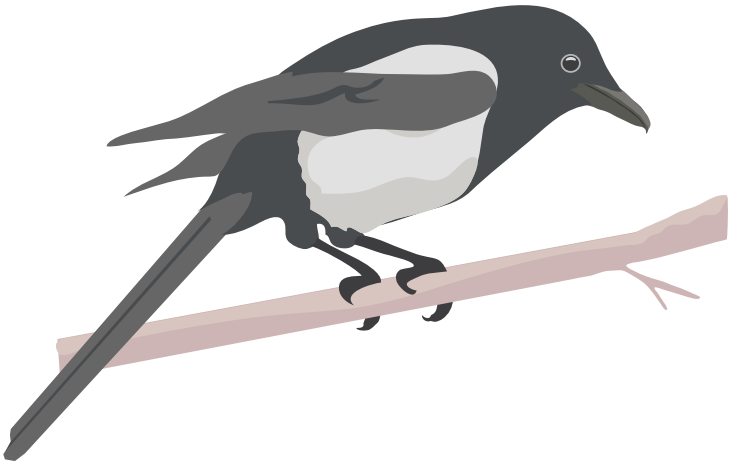
2. Where do they find all the water they need?

3. What do the animals do if water becomes scarce? How do they make sure they don't dehydrate?

4. Where are the kidneys (if present)? Draw a diagram of the body.

3 Presentation

The method of presentation can vary depending on the maturity level. Posters and illustrated talks are easy, and fit into a normal lesson time. After group research, it is suggested that each pupil writes-up their findings individually, and then each group feeds back to the class.



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Resource sheet 1

Cardsort

The cardsort and the concept cartoon are aimed at promoting discussion and clarification of any misunderstandings. The cardsort could be organised by having groups of pupils arranging the cards into three piles: agree with, disagree with and unsure/sort of, then feeding back to the rest of the class, and finishing up with a class discussion, with the teacher explaining any points of difficulty. The concept cartoon could be done in much the same way, but also groups could be challenged to write three additional accurate statements on the sheet.

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Resource sheet 2a

Hand washing

1st Chunk

Germs!

Germs can also be called micro-organisms, or in other words small living things that cannot be seen by the naked eye. They can be found almost everywhere: high in the atmosphere, deep under the oceans, at the poles - and all over our bodies!

The main micro-organisms are bacteria, viruses, fungi and parasites. Some of these can cause diseases. Others, like the yeast that makes bread rise, are useful.

Bacteria can live anywhere, including in food and water and inside our bodies. Most sorts of bacteria are completely harmless, and in fact there are lots that we need to keep us healthy. Some bacteria protect us from harmful germs, for example, and others help us to digest food properly. Bacteria can be various shapes, such as spirals, rods, commas and dots.

Some micro-organisms can harm us, and can cause infections. Bacteria can give us scarlet fever, meningitis and some food poisoning, like salmonella. Viruses are much smaller than bacteria, and cause many of the childhood diseases like mumps, measles, rubella and chicken pox. Winter vomiting sickness is also caused by a virus, and so is HIV. Fungal infections include ringworm and athlete's foot. Head lice are common parasites, although they aren't really 'germs'.

2nd Chunk

How do we catch infections?

The main ways are:
1. Through the air. We can catch diseases if somebody coughs or sneezes near us. If that person has a disease, like a cold, then we catch it by breathing in the tiny droplets that they sneeze or cough out.

2. Through contact. Some diseases can be transferred by touch, especially diseases of the skin, like ringworm. Head lice are also transmitted by head-to-head contact. If we have a cut in our skin, infections can get in that way, which is one reason for covering up any break in the skin quickly.

3. Through indirect contact. If someone has dirty hands and touches a surface, for example a doorknob, and then we touch that same surface, we can pick up germs that way. This especially applies when people are preparing food: if they don't wash their hands properly we can pick up diseases from them. That can easily happen if the person who is preparing the food has vomiting and diarrhoea, and goes to the toilet but does not wash their hands properly afterwards.

4. Through animals. Pets, like cats and dogs, clean themselves by licking all over, which spreads many germs over their fur. The germs can then spread to our hands when we pet them, and then to our mouths if we don't wash our hands. Some people think it is very unhealthy to allow pets to sleep on our beds with us. Some diseases can be spread by insects, like malaria, which is carried by mosquitoes. Others are carried by the fleas that live in an animal's fur.

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Resource sheet 2b

Hand washing

3rd Chunk

What can we do about it?

Hand washing is by far the best way of stopping the spread of disease by direct or indirect contact. Many people think that, in public toilets, liquid soap and either paper towels or hot air dryers are best. Using these properly and regularly will remove most germs.

So, when should we wash our hands?

- Before eating food
- Before preparing any food
- After using the toilet
- After contact with blood, vomit or other body fluids
- After handling pets, pet cages or anything pets have touched
- After going out to play
- After coming into contact with anything particularly dirty, like rubbish bins

Washing with soap and water will only work if it is done properly. We need to wash the backs and fronts of our hands, and the tips and sides of our fingers. A blob of soap and plenty of warm water to sluice it off (very hot water isn't necessary).

Ideally, drinking water fountains should not be near the toilets, and the whole area should be kept very clean of course.

4th Chunk

Facts and figures

You have between 10000 and 10 million bacteria on each hand.

Damp hands spread 1000 times more germs than dry hands.

The number of germs on your fingertips doubles after you use the toilet.

Only about 70% of people wash their hands after being to the toilet.

Bacteria 40 million years old have been extracted from a fossilised bee, and grown.

In 1918 about 30 million people died from 'flu, caused by a virus. That is three times as many as those who died in the First World War, which ended in that year.

When you cough, germs spray out about 3 metres if you don't put a hand or handkerchief over your nose and mouth.

Bacteria double their number every 20 minutes, so at the end of a lesson you might have four times as many bacteria on you as you started with.

Almost one million bacteria can be created by one person in one day.

Source: www.discoveryuk.com

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Resource sheet 3

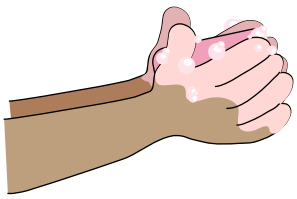
How do I wash my hands properly?

Washing your hands properly takes about as long as singing 'Happy Birthday" twice.
Clean your hands using the images below.

1

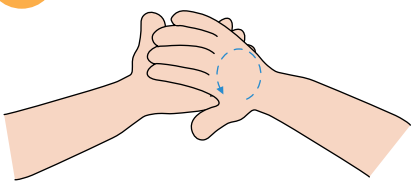
Wet your hands with water. Turn off the tap.

2



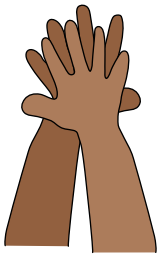
Apply enough soap to cover your hands.

3



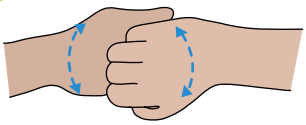
Rub your hands together, palm to palm.

4



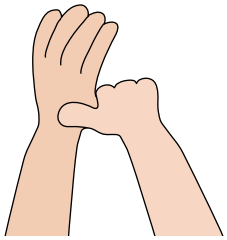
Scrub the backs of your hands, in between fingers and finger nails.

5



Clean the backs of your fingers with your fingers interlocked.

6

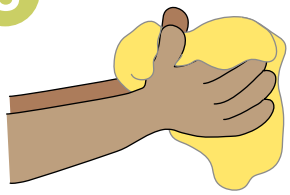


Rub your thumb in to your palm on each hand in turn.

7

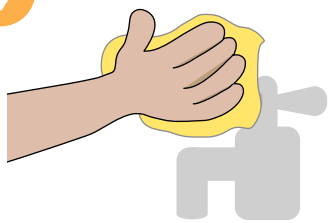
Rinse your hands well with water.

8



Dry your hands thoroughly with a single use towel.

9



Use the towel to turn the tap off.

Your hands are now clean

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Resource sheet 4a

All about kidneys

Where are our kidneys?

Most people are born with two kidneys. They are bean-shaped, and each is a bit less than the size of your fist. They are under the rib cage in the small of your back; there is one on each side of the backbone. They are protected from injury by a padding of fat, by your ribs and by muscles.

What happens when we eat?

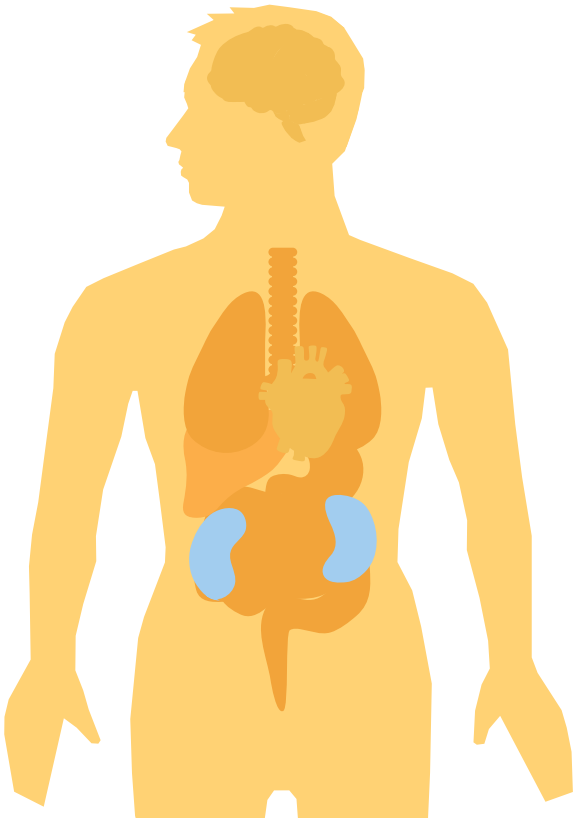
- Food and drink are taken into the body and are broken down into substances the body can use: nutrients
- Solid food waste passes on through the gut, and out of the body
- Nutrients are absorbed and used by the body to keep it alive
- The waste products from that are removed by the kidneys
- The waste products, with some water, move from the kidneys to the bladder, then leave the body as urine

What do kidneys do?

The kidneys are an amazing waste disposal system. They filter the blood and get rid of stuff the body doesn't want, like the waste products produced when we use food. Some people call these wastes 'toxins', which means poisons – which is what they would be if they built up in the bloodstream. Some of these waste products are urea, salts and excess water; together these make up urine, or 'pee'.

What can we do to keep healthy?

- Eat healthily and not too much. That way your body won't have to deal with too much sugar, fat and salt, which overload the kidneys
- Drink enough water. If you're drinking enough, your pee will be a pale colour, but if it's yellow have some water. The kidneys need water to get rid of the waste. Also, if your pee is concentrated a lot, the waste products can form solid lumps called kidney stones, which are very painful
- Don't drink too much alcohol. Alcohol makes us pee too much, which dehydrates the body and makes us feel very ill
- Don't smoke. Smoking narrows the blood vessels in the kidneys and stops them working properly. Smoking is also linked with cancer of the kidneys and bladder



Kidneys

Scottish Water
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Our bodies and water

Resource sheet 4b

Kidneys notes

1 Where are our kidneys?

2 What happens when we eat?

3 What do kidneys do?

4 What can we do to keep healthy?