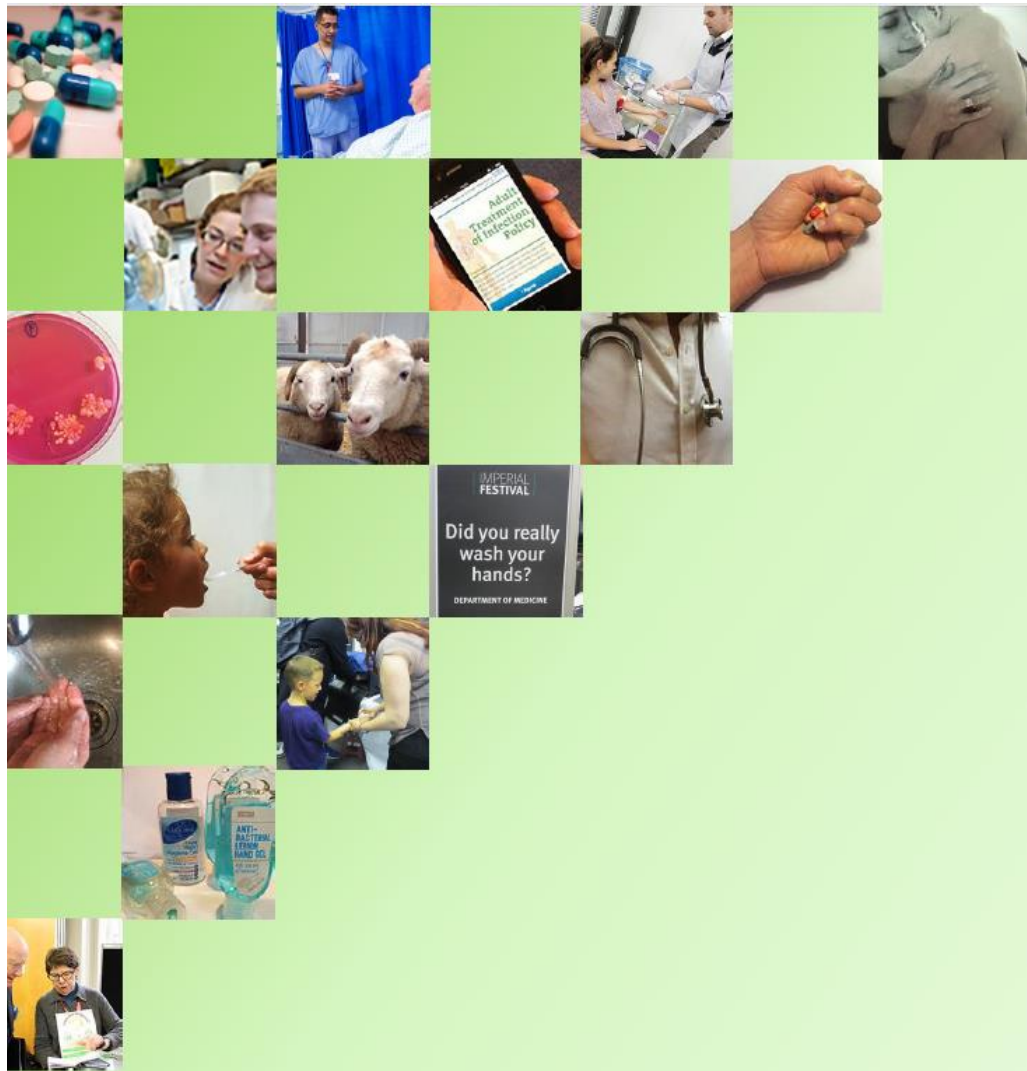


Health Protection Research Unit in Healthcare Associated Infections & Antimicrobial Resistance

NHS
National Institute for
Health Research



**Imperial College
London**

Lesson plans and learning resources

The spread of infection: Hand Hygiene

Upper Key Stage 2 Science and PSHE

Time needed: 2 x 60 minutes

The Spread of Infection: Hand Hygiene

These lessons aim to help students understand that effective hand washing is important to minimise the risk of infection from potentially harmful bacteria. Students will carry out a simple experiment to observe how bacteria can spread from person to person simply by shaking each other's hands. Pupils will also test whether soap is an effective method for hand washing.

Members of the HPRU can help deliver these lessons at West London locations as part of our Patient and Public Engagement Activities. To request our involvement please contact:

head.ops@imperial.ac.uk

National Curriculum Links

- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.
- Using test results to make predictions to set up further comparative and fair tests.
- Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.
- Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

Ideally Lesson 1 should precede lesson 2 – but lesson 2 can be delivered as a stand-alone.

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Lesson 1 Objectives

The objective of the lesson is to teach students when and why we need to wash our hands.

By the end of the lesson:

- All students will be able to describe **when** hands should be washed.
- All students will be able to describe **how** hands should be washed.
- Most students will be able to explain **why** hand washing is important.
- Some students will be able to describe how to conduct an experiment to **test** whether soap and water removes bacteria from hands.

Background Information

Our skin, including our hands, provides a natural breeding ground for bacteria to grow. Our skin is typically covered in vast numbers of bacteria. It is estimated the total number of bacteria on the average human at any one time is around 1 trillion. Most of these bacteria have a useful role in protecting us from other bacteria that could potentially cause us harm through illness.

Sometimes bacteria that can cause us harm will grow on our skin. These bacteria may cause different types of infection that could make us very ill. For example food poisoning can be caused by a bacteria called Salmonella and is spread by touching or eating contaminated foods.

Washing your hands is one of the best ways to protect yourself from infection from bacteria that could cause you harm. It can also help to stop these bacteria from spreading to other people. Washing our hands regularly helps to remove the potentially harmful bacteria we collect from our surroundings during our normal day-to-day routine, for example in the home, at school, in the garden, playing with animals, or preparing food.

Lesson 1 Preparation

You will need:

- Nutrient agar gel powder and petri plates with lids OR pre-mixed nutrient agar plates.
- Sellotape
- Marker pens
- Plate labels
- Pupil worksheets
- Warm water and soap
- Paper towels

Agar plates can be purchased from a number of suppliers for around £20 for 20 plates.

Potential suppliers include:

- www.fisher.co.uk
- www.cherwell-labs.co.uk
- www.betterequipped.co.uk

Preparation

1. Make up the nutrient agar plates according to the instructions on the packet. Leave to set if required.
2. Draw a line down the base of each plate. Label one side “dirty” and one side “clean”.
3. Stick a label near the edge of the lid of each plate. Make sure the gel is still clearly visible through the lid.

Lesson 1 Plan

Timing	Activity	Resources
Introduction		
2 minutes	Lesson aims and objectives to be clearly explained to pupils and displayed	PowerPoint provided (S1)
8 minutes	Using the slides provided with this lesson plan ask the class who has washed their hands today. Give pupils 2 minutes to discuss with the partner next to them when they washed their hands and why. Bring the class together to come up with a list of times when we should wash our hands and why. Ask class why it is especially important to wash your hands.	PowerPoint (S1)
a5 minutes	Using the slides provided introduce pupils to the idea that nearly a trillion bacteria live on the average human at any one time. We pick these up every time we touch something, for example when we play with pets or prepare food. Most of these bacteria are useful and protect us from other bacteria that can cause harm. However, sometimes we pick up bacteria that can cause us harm. These bacteria can cause infection e.g. food poisoning. Washing hands removes these bacteria.	PowerPoint (S1)
Main Activity		
50 minutes total		
10 minutes	Show pupils the dangerous hands image. Describe a scenario where the pupils are a group of scientists working for a public health department. The department wants to prove that using soap is the best method of removing potentially harmful bacteria when hand washing. In small groups or tables, pupils will discuss how they could test if using soap is an effective way of removing harmful bacteria from hands. Discuss experiment ideas as a class.	PowerPoint (S1)
3 minutes	Introduce the main activity to the class. The class will be investigating whether using soap and warm water is an effective way of removing potentially harmful bacteria from hands.	PowerPoint (S1)
Activity 1	Agar plates.	
5 minutes	Explain to pupils that agar plates contain a jelly that provides food for bacteria to grow very quickly. Ask pupils how agar plates may help us to find out if using soap is an effective way to wash our hands.	Slides, prepared agar plates, pens. Teacher instruction sheets (T1)

5 minutes	Provide each pupil with an agar plate and experiment sheet.	Pupil experiment sheets (P1)
17 minutes	<p>Each pupil should put a handprint on the side labelled dirty and then pupils should wash their hands thoroughly and place handprint on the side labelled clean (Alternatively half the class will print dirty hands and half clean). Pupils can wash hands one table at a time. Pupils can complete experiment sheet whilst waiting for others to complete the experiment.</p> <p>Collect in agar plates and leave in warm dark place for 48 hours as per instructions on Agar Plates - teacher guide.</p>	<p>Label templates</p> <p>Sink, soap, water</p>
Plenary		
5 minutes	<p>Explain that you will return to the agar plates in two days. Ask pupils to discuss which side of the agar will grow the most bacteria and why and write down their prediction.</p> <p>How would this result help scientists tell whether soap is effective at removing harmful bacteria from hands?</p>	<p>Slides</p> <p>Pupil experiment sheets (P1)</p>

Lesson 2 Objectives

The objective of the lesson is to teach students the best way to wash hands. This lesson can be delivered as a stand-alone.

By the end of the lesson:

- All students will be able to explain **when** and **how** to wash hands.
- Most students will be able to **demonstrate** the best way of washing hands.
- Some students will be able to describe how to conduct an experiment to **test** the best way to wash hands.

Background Information

In the previous session we learned that our hands pick up bacteria from our surroundings (*if delivering as a stand-alone use Power Point S1 Summary as an introduction*). Some of these bacteria are harmless, but some can cause harm, such as stomach upsets or infections. Washing our hands regularly removes these potentially harmful bacteria.

Rinsing hands in cold water may remove all visible signs of dirt and grime. However washing hands in soap and warm water is a much more effective method to remove potentially harmful bacteria from our hands. Below are some examples when hands should be washed:

- before, during and after preparing food
- After using the lavatory
- After exposure to animals or animal waste
- After coughing, sneezing or blowing your nose
- If you're ill or have been around ill people

You may have seen campaigns (posters, adverts) to remind us to wash our hands with soap and warm water for at least 20 seconds. This is approximately the same time it takes to sing "Happy Birthday" twice.

Lesson 2 Preparation

You will need:

- Agar plates from the previous session
- Prediction from pupil experiment sheets from the previous session (P1)
- Glo gel
- UV torch
- Two basins of warm water
- One basin of cold water
- Soap
- Paper towels

Potential suppliers include:

- foodsafetydirect.co.uk,
- glowtech.co.uk
- handinspection.co.uk
- hygienicsolutions.uk
- uvgear.co.uk

ON THE DAY OF THE LESSON arrange four desks side by side.

Desk 1 – A sign saying unwashed hands

Desk 2 – A basin of water and a sign saying ‘Hands washed with cold water’

Desk 3 – A basin of warm water, and a sign saying ‘Hands washed with Warm Water’

Desk 4- A basin of warm water and some soap and a sign saying ‘Hands washed with Warm Water and soap’

Have your glo gel and AV light ready, or oil and glitter. If the Imperial team are supporting the lesson they will bring glo gel and AV lights with them.

Lesson 2 Plan

Timing	Activity	Resources
Introduction		
2 minutes	Lesson aims and objectives to be clearly explained to pupils and displayed	Power point provided (S2)
5 minutes	Recap why it is important to wash our hands.	Power point provided (S2)
10 minutes	Hand out the agar plates and prediction sheets from the first session. Emphasise that pupils should not remove the lids as the bacteria may be harmful. Pupils should fill in the results section of the sheet to show how the bacteria has grown and complete the conclusion sentence. <i>If delivering as a stand-alone lesson use the S1 Summary Power point here</i>	Agar plates, prediction from the pupil experiment sheet (P1) <i>OR If delivering as a stand-alone lesson use the S1 Summary Power point here</i>
Main Activity		
3 minutes	Introduce the main activity to the class. We know from the agar plates that washing hands in soap and water removes bacteria, but is this the best way to wash hands? Pupils will be conducting an experiment to test whether soap and warm water is the most effective method of hand washing.	
20 minutes	<p>Hand washing experiment</p> <p>Divide the students into four groups. Ask each group to line up in front of a desk:</p> <ul style="list-style-type: none"> - Cold water - Warm water - Warm water and soap - No wash (control group) <p>Important to keep the line of students differentiated so a little space between the lines is advised.</p> <p>Put a blob of glo-gel on the hands of the first student in each line. Tell them to spread it all over their hands. Explain that the glo-gel represents the microbes that we all have on our hands. Demonstrate that it glows under a blacklight.</p> <p>Once the gel has been rubbed in, tell the front students to wash their hands as directed on the sign. One will of course not wash hands.</p> <p>After washing their hands the front students turn around and shake hands firmly with the next student in line. The</p>	<p>Three basins of water, one cold, two warm.</p> <p>Soap</p> <p>Glo-gel</p> <p>UV light</p> <p>Handwashing pupil sheets (P2)</p> <p>Teacher instruction sheet (T2)</p>

	<p>second student then shakes hands with the third student, and so on until the end of the line is reached.</p> <p>Use a UV light to check each student's hands for glo-gel. Check both sides of their hands and focus on the creases between fingers as this is where gel is most likely to remain after hand washing. The aim is to show how far down the line the gel (and also the microbes) has spread.</p> <p>Ask one or two students to stick hands on the wall to show how far along each line the glo-gel spread.</p> <p>Students should record the findings of the experiment on the sheet provided.</p>	
Plenary		
10 minutes	Show students the recommendations for hand washing. Pupils will then practice the correct method of hand washing.	Hand washing slide.
10 minutes	Mini quiz	Quiz sheet (Q1) provided

Advanced group – or extension activity

Write up the experiment and using the following words:

Independent variables

dependent variables

control

Home learning extension

Pupils to pass on learning to someone at home (parents, siblings, friends). They could create their own poster on how to wash hands, or create a story board showing times during the day when hands should be washed.

T1 Agar Plates – Teacher Guide

Resources Needed

- Nutrient agar gel powder and petri plates with lids OR pre-mixed nutrient agar plates.
- Sellotape
- Marker pens
- Plate labels
- Pupil worksheets

Preparation

1. Make up the nutrient agar plates according to the instructions on the packet. Leave to set if required.
2. Stick a label near the edge of the lid of each plate. Make sure the gel is still clearly visible through the lid.

Method – Lesson 1

1. Use the lesson slides provided and the pupil sheets to introduce the activity. Explain to the pupils that agar plates contain jelly that provides an ideal environment for bacteria to grow.
2. As a class discussion, explore what pupils think the outcome of the investigation may be, i.e. which side will grow more bacteria: clean or dirty and why? Pupils will write their predictions on the pupil sheet.
3. Each pupil will be provided with an agar plate and will draw a line using a marker pen down the centre of the base of the agar plate. Pupils will also label their plates with their name.
4. Instruct pupils to place fingers on the side of the plate labelled “dirty”, making sure that their fingers do not go over the line. It is important that pupils do not press too hard as this will break the jelly.
5. Send pupils at table at a time to wash their hands with warm water and soap in the sink and dry with a paper towel. Pupils are to return to their desk once hands are clean.
6. Once hands are clean each pupil should place their fingers on the side of the plate labelled “clean”, again making sure pupils fingers do not go over the line.
7. Pupils should tape the lids onto the plates.
8. Whilst pupils are waiting pupils can complete the hand hygiene crossword sheet provided.
9. Collect the plates and put them in a warm place for 48 hours.
10. Give each pupil a prediction sheet. Ask them to predict what the plates will look like after 48 hours.

Incubate the plates for 48 hours. Do not remove the lids.

Method – Lesson 2

1. **Recap on the agar experiment from last lesson**
2. Hand out the pupil experiment sheets (P1) and the agar plates. Emphasise that pupils must not remove the lids as the bacteria may be dangerous.
3. Instruct pupils to complete the results section on the pupil sheet by drawing the result they have observed on the agar plate. Pupils must then describe their findings on the sheet in a couple of sentences.
4. Pupils should complete the conclusion section of the sheet.
5. Collect the agar plates and put them in a safe place ready for disposal.

Disposal

While wearing rubber gloves, saturate the plates with a 20% or "1 in 5" household bleach solution (in other words, 1 part bleach and 4 parts water). Let them sit and soak overnight in the bleach solution before disposing of them. Thoroughly rinse the container and your gloves with clean water to remove the bleach solution. Be careful not to get any on your skin.

P1 Agar Plates pupil experiment sheet

How clean are your hands?

Method

1. Draw a line on the back of your plate, right down the middle.
2. Write your name on the name label.
3. Place your hand gently on the side of the agar plate labelled “dirty”.
4. Wash your hands thoroughly with soap and water.
5. Place your hand gently on the side of the agar plate labelled “clean”.
6. Carefully tape the lid onto the agar plate.

Now give the agar plate back to your teacher. The plates will sit in a warm place for 48 hours to give the bacteria time to grow.

Prediction

I predict that there will be more/less bacteria on the clean/dirty side of the plate because:

P1 Agar Plates pupil experiment sheet

Results

Use the boxes below to show where the bacteria grew on your agar plate. Don't open the lid! Remember, some of the bacteria could be harmful.

<p style="text-align: center;">Dirty</p>	<p style="text-align: center;">Clean</p>
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Conclusion

My prediction was correct/wrong. I predicted that:

This was correct/wrong because:

Desk signs

Do not wash

Desk signs

Cold water

Desk signs

Hot water

Hot water and
soap

What is the best way to wash your hands?

How far did the microbes travel in each group?

Cold water	hands
Hot water	hands
Hot water and soap	hands

Conclusion

The best way to wash your hands is:

Because:

T2 Hand Washing – Teacher Guide

Resources Needed

- Glo gel
- UV torch
- Two basins of warm water
- Basin of cold water
- Hand soap

Preparation

Arrange four desks side by side.

Desk 1 – A basin of cold water and a sign saying ‘Wash Hands in Cold Water’

Desk 2 – A basin of warm water and a sign saying ‘Wash Hands in Warm Water’

Desk 3 – A basin of warm water, some soap and a sign saying ‘Wash Hands with Warm Water and Soap’

Desk 4 – A sign saying ‘Do not wash hands’

Method

1. Divide pupils into four groups. Each group lines up in front of one of the desks.
2. Put a blob of glo-gel on the hands of the first student in each line. Tell them to spread it all over their hands. Explain that the glo-gel represents the microbes that we all have on our hands. Demonstrate that it glows under a UV light.
3. Once the gel has been rubbed in, tell the front students to wash their hands as directed on the sign.
4. After washing their hands the front students turn around and shake hands firmly with the next student in line. The second student then shakes hands with the third student, and so on until the end of the line is reached.
5. Use a blacklight to check each student’s hands for glo-gel. Check both sides of their hands and focus on the creases between fingers as this is where gel is most likely to remain after hand washing. The aim is to show how far down the line the gel (and also the microbes) has spread.
6. Students should record the findings of the experiment on the sheet provided.

Q1 hand washing quiz sheet

Hand Washing – Quiz Questions

Pupils should stand up if the statement is true and sit down if it is false.

1. There are nearly one trillion bacteria on the average person at any one time.

Answer: True.

2. Washing hands in warm water removes the same amount of bacteria as washing hands with warm water and soap.

Answer: False. Washing with warm water and soap is the most effective method of removing bacteria.

3. You don't need to wash your hands if they look clean.

Answer: False. Bacteria are too small for human eyes to see. You might have harmful bacteria on your hands even if they look clean.

4. You should wash your hands after using the toilet.

Answer: True. Toilets and bathrooms often contain lots of bacteria. It is very important to wash your hands after using the toilet.

5. When washing your hands you should scrub with soap for at least 20 seconds before rinsing.

Answer: True. The World Health Organisation recommends scrubbing with soap for at least 20 seconds then rinsing with warm water. If you only wash your hands quickly, or you don't use soap, there might be some bacteria left on your skin. 20 seconds is roughly the time it takes to sing 'Happy Birthday' twice.

6. You can't pick up bacteria by touching other people.

Answer: False. We pick up bacteria from everything we touch, including other people.

7. All bacteria are harmful.

Answer: False. Most bacteria are harmless, and many are helpful, like the bacteria that help with digestion. However, some bacteria can be harmful. We should wash our hands regularly to remove the harmful bacteria.

8. You should always wash your hands before eating.

Answer: True. When we eat we put our hands near our mouths, which means bacteria can get inside our bodies. If harmful bacteria get inside us they can make us ill.