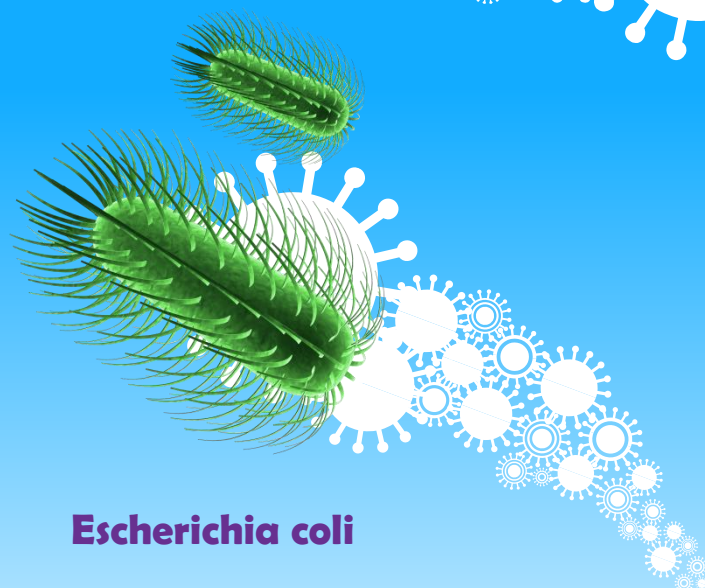




2.1 HAND HYGIENE

This section aims to teach students how poor hand hygiene can lead to the spread of microbes and disease.

In 2.1 Hand hygiene, students carry out an experiment to observe how microbes can spread from person to person simply by shaking their hands. They will also have to decide which method is best for hand washing.



Escherichia coli

LEARNING OUTCOMES

All students:

- Will understand that sometimes microbes can make us ill
- Will know that prevention of infection, where possible, is better than cure
- Will understand not to spread their harmful microbes to others
- Will know how, when and why to wash their hands

NATIONAL CURRICULUM LINKS

Key Stage 3

Science

Working Scientifically

Scientific Attitudes

Experimental skills and investigations

Analysis and Evaluation

PSHE

Core Theme 1: Health and Wellbeing

Estimated Teaching Time

50 minutes



e-Bug

Key Words

Antibacterial soap
Colony
Contagious
Hygiene
Infection
Infectious
Transfer

Materials Required

Per student

- ☐ Copy of [SW 1](#)
- ☐ Copy of [SW 2](#)
- ☐ 3 Petri dishes of nutrient agar

Per group

- ☐ Copy of [SH 1](#)
- ☐ Copy of [SH 2](#)
- ☐ Towel/hand dryer/paper towels
- ☐ Permanent marker pen
- ☐ Soap
- ☐ Warm water

Health and Safety

- It is important that the Petri dishes stay closed whilst examining the microbes
- Ensure that all students wash hands after participating in the activity

Available Web Resources

- A demonstration film
- [SH 1](#) and [SH 2](#)
- Images of results
 - Alternative Activity

2.1 Spread of Infection

Hand Hygiene

Background Information

Schools are a haven of harmful microbes which spread rapidly from person to person via touch. Washing our hands is the best tactic to stop the spread of harmful microbes and prevent people getting sick.

Our hands naturally secrete oil which helps keep our skin moist and stops it getting too dry. This oil provides a perfect place for microbes to grow and multiply and also helps microbes 'stick' to our skin. Our hands are also covered by our good bacteria – harmless species of *Staphylococcus*. Washing our hands regularly helps remove the other microbes we collect from our surroundings (e.g. home, school, garden, animals, pets, food). Some of these microbes can make us ill if ingested.

Washing hands in water alone or in cold water eliminates visible dirt and grime, however, soap is required to break up the oil on the surface of the hands which traps microbes.

Hands should be washed:

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

Advance Preparation

1. Copy [SW 1](#), [SW 2](#), [SH 1](#) and [SH 2](#) for each student.
2. Have hand washing facilities available, (soap, warm water, a means to dry hands).
3. Prepare 2/3 Petri dishes of nutrient agar per student.

Alternative Suggestions

Slices of white bread can be used as alternatives to Petri dishes of nutrient agar. Students should put a hand print on the bread and place inside a food storage bag with a few drops of water. Store the bags upright in a dark place in a similar fashion to the Petri dishes.

NOTE: This method is not as accurate as using the Petri dish method and fungal colonies will grow as opposed to bacterial colonies. Student worksheets may need to be modified.





2.1 Spread of Infection Hand Hygiene

Lesson Plan

Introduction

1. Begin the lesson by asking the class 'if there are millions of disease-causing microbes in the world that live everywhere, why aren't we ill all the time?' Provide students with [SH 1](#) (The chain of Infection) and [SH 2](#) (Breaking the Chain). Use the MS PowerPoint presentation found at www.e-bug.eu to help explain this.
2. Highlight that there are many different ways in which microbes can be transmitted to people. Ask students if they can think of any. Examples include through the food we eat, the water we drink and bathe in, the things we touch and from sneezing.
3. Ask students: How many of you have washed your hands today? Ask why they washed their hands (*to wash away any microbes that might be on their hands*), and what would happen if they didn't wash away the microbes (*they might get ill*).
4. Tell the students that we use our hands all the time, and that they pick up millions of microbes every day. Although many of these are harmless some could be harmful.
5. Explain to the class that we spread our microbes to our friends and others through touch, and this is why we wash our hands.
6. Explain to students that they are going to do an activity to show them how best to wash their hands to remove any of the harmful microbes which may be on their hands.

Main Activity

NOTE 1 If time does not permit to carry out the full activity, results can be viewed on the website, www.e-bug.eu.

Section A

1. Provide each student in the class with a copy of [SW 1](#) and a Petri dish of nutrient agar, ask each student to divide the dish in half by drawing a line on the **base** of the Petri dish. Label one side clean and the other side dirty. **NOTE 2** Students should not label the lid.

NOTE 3 Care must be taken not to mix up the dirty and clean side of the plate as this will lead to confusing results. Using 2 plates, one for clean hands and one for dirty hands, may help prevent this problem.

2. Each student should put a hand print on the side labelled 'Dirty'. Students should then wash their hands thoroughly and place a hand print on the side labelled 'clean'.
3. Place the Petri dish in a warm dark place for 48 hours and examine the plates during the next lesson. Students should record their results on [SW 1](#).

On the dirty side of the plate students should observe a range of different bacterial and fungal colonies; each different colony type represents a different bacterial or fungal strain – some natural body flora and some contamination from areas they have touched. Students should examine these carefully and describe their morphology and how many of each type of organism they see.

On the clean side of the plate students should observe a distinct decrease in the number of different types of colonies observed. This is because hand washing has removed many of the organisms the students have 'picked up' through touch. The organisms left growing on the plate are the body's natural flora. The quantity of these colonies may be higher than on the dirty side of the plate. This is because washing can bring the harmless microbes out of the hair follicles but these are usually one type of microbe. You can tell the difference between harmless and harmful microbes as there tend to be several different species of harmful microbe.





2.1 Spread of Infection Hand Hygiene

Lesson Plan

Main Activity

Section B

1. Divide the class into 4 even groups of students (a, b, c, d).
2. Ask each group to choose a lead person who is NOT going to wash their hands. Everyone else in the group should wash their hands as thoroughly as possible with soap (if available) and water. Students should dry their hands with either an air hand dryer or a clean section of tissue. The student NOT washing his/her hands should touch as many items in the classroom as possible to pick up lots of microbes including door handles, sink taps, shoes, etc.
3. Ask students to stand in 4 rows one behind the other and designate groups as follows
 - a. No hand washing *Control group*
 - b. Wash hands in warm water very quickly *Dip hands in water and rub quickly*
 - c. Wash hand in warm water thoroughly
 - d. Wash hands in warm water & soap thoroughly
4. Provide each student in the class with 2 nutrient agar plates and a copy of [SW 2](#).
5. Each student should put a hand print on one of their agar plates and label appropriately.
6. The lead student (student 1) should then wash their hands according to the group they are in. Student 1 should then turn around and shake hands with student 2 making sure to have as much hand contact with the person as possible. Student 2 in turn should shake hands with student 3 and so on until they reach the end of the row.
7. Each student should now make a hand print in their second nutrient agar plate and label appropriately.
8. Place the nutrient agar plates in a warm dry place for 48 hours. Ask students to view and record their

Plenary

1. Discuss the results with the students. What results did they find the most surprising? Explain that microbes can stick to the natural oil found on our skin. Washing with water alone flows over this oil and does not wash it away. Soap breaks up this oil so that the water can wash away the microbes.
2. Discuss where the microbes on their hands may have come from. Emphasise to students that not all the microbes on their hands are bad; there may also be normal body microbes there too which is why good microbes may increase following hand washing.

Extension Activity

Ask students to research the controversy as to the pros and cons of using antibacterial soaps. It may be a good idea to divide the class into groups of 4 people and ask each group to research the topic and have a classroom debate. Alternatively, students can write a short essay outlining the argument for and against and draw their own conclusion from the evidence.





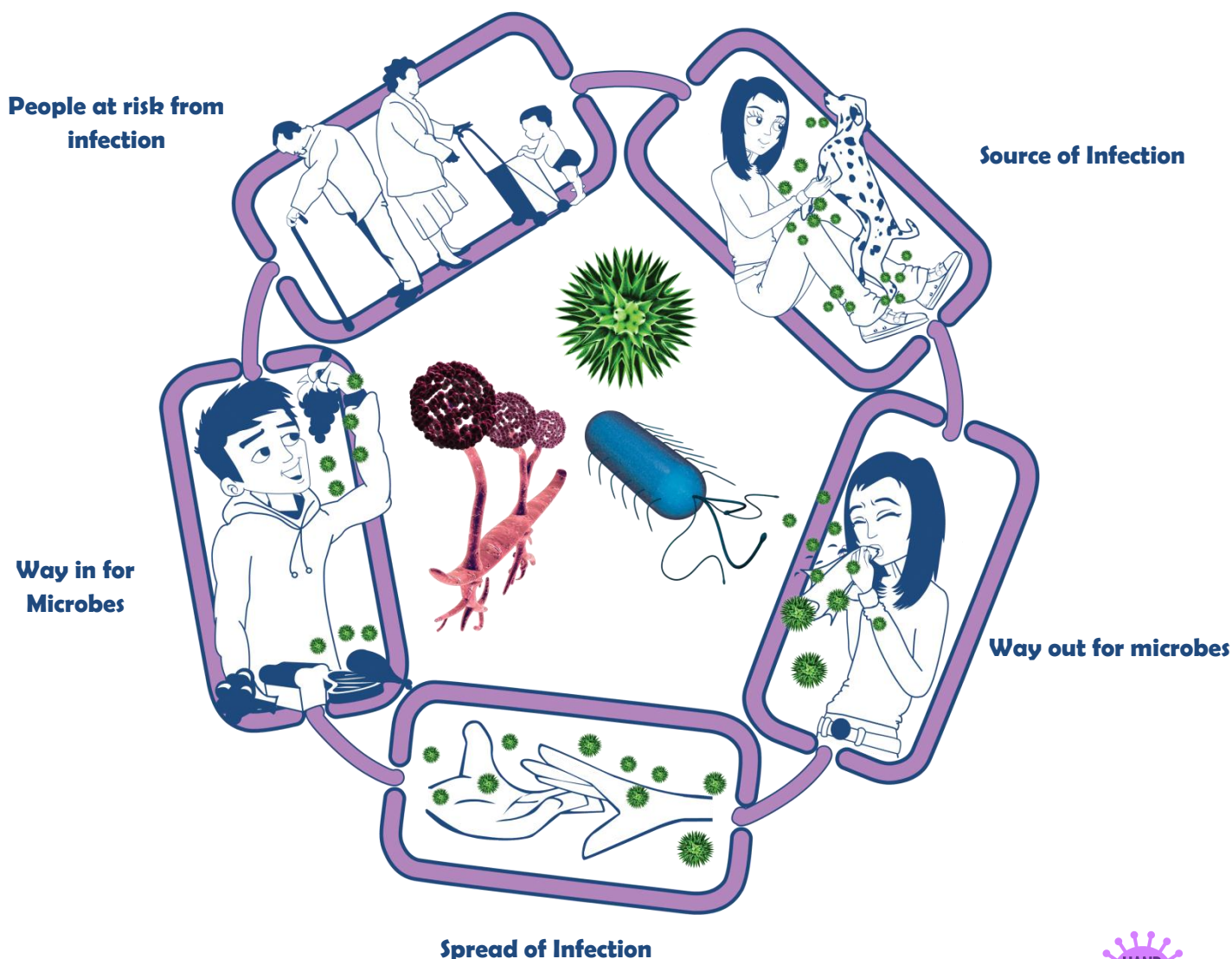
2.1 Spread of Infection

Hand Hygiene

Alternative Activity

Activity

1. This activity can be carried out in groups of 2 – 4 students or as a classroom discussion.
2. Ask students if they have ever had a tummy bug. With the help of [SH 1](#) and [SH 2](#), ask students to imagine the spread of gastroenteritis (a tummy bug) in their school from a single infected student.
3. Ask the class to take into account the situations of everyday life in school (going to the toilets without washing hands or washing them without soap, go to eat at the school canteen, borrow pens or other things from friends, shake hands, use a computer...).
4. Ask the groups/class to report on ways in which the infection could spread and how quickly it could spread in their class or in the school.
5. Suggest the students think about and discuss the difficulties they encounter with respect to hand hygiene in school and to suggest how to use the existing hygiene facilities better.





2.1 Spread of Infection

Hand Hygiene

Teacher Answer Sheet

Results

Draw and describe what you observed in the Petri dish



Dirty section

- Colony 1 *large round cream colonies with a white centre*
- Colony 2 *small yellow colonies*
- Colony 3 *very small cream colonies with irregular shape*
- Colony 4 *small cream round oval colonies*
- Colony 5 *small round white colonies*

Clean section

- Colony 1 *small round white colonies*
- Colony 2 *small cream round oval colonies*

Observations

1. Which side of the Petri dish contained the highest number of microbes?

Clean

2. Which side of the Petri dish contained the most different colonies of microbes?

Dirty

3. How many different colony types were there on the:

Clean	2	Dirty	5
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Conclusions

1. Some people may see more microbes on the clean side of the Petri dish than the dirty side.
Why?

*There may be more microbes on the clean side than the dirty side but if students have washed their hands correctly there should be a lower number of **different types** of microbes. The increase in the number of microbes is probably due to microbes from the water or the paper towel used to dry their hands.*

2. Which colonies would you consider the friendly microbes and why?

The microbes on the clean side as they are probably the natural microbes found on our hands.

Conclusion

1. Which method of hand washing eliminated the most microbes?

Hand washing with soap and warm water.

2. Why would soap help eliminate more microbes than washing with water alone?

Soap helps to break up the natural oil on your skin to which microbes can stick.

3. What are the advantages and disadvantages to using antibacterial soap when washing your hands?

Advantages: kill any unwanted microbes Disadvantages: also kill natural skin microbes

4. What evidence do you have that microbes can be transmitted by hands?

The types of microbes on the first plate are spread along to the other plates and the numbers are gradually decreasing.

5. Which areas of the hand would do you think would contain the most microbes and why?

Under the finger nails, on the thumbs and between the fingers as these are places that people either forget to wash or don't wash very well.

6. List 5 times when it is important to wash your hands

- | | | |
|--------------------------|------------------------------------|----------------------------------|
| a. <i>Before cooking</i> | b. <i>After touching pets</i> | c. <i>After using the toilet</i> |
| d. <i>Before eating</i> | e. <i>After sneezing into them</i> | |





HAND HYGIENE

The chain of Infection

People at risk from infection

We are all at risk from infection.

High risk people include

- Those already on medication
- The very young
- The elderly

Way in for microbes

Harmful microbes need a way to enter the body before they can cause an infection. This can be through:

- The food we eat
- Inhalation of aerosols
- Open cuts or sores
- Things we put in our mouths

Source of Infection

Someone or something carrying the harmful microbes that causes the infection. There are many different sources of infection, these can include

- People already infected
- Pets or animals
- Unclean surfaces (e.g. door handles, keyboards, toilets)

Way out for microbes

Harmful microbes need a way to get out of an infected person or source before they can spread to someone else. Routes include

- Sneezing and coughing
- Bodily fluid

Spread of Infection

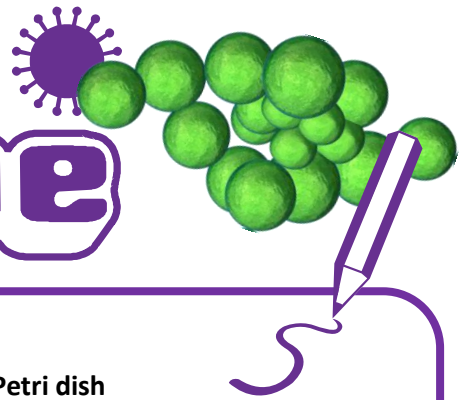
Harmful microbes need a way to be passed from person to person. This can be through

- Touch
- Sexual transmission





HAND HYGIENE



Results

Draw and describe what you observed in the Petri dish



Dirty section

Colony 1 _____
Colony 2 _____
Colony 3 _____
Colony 4 _____
Colony 5 _____

Clean section

Colony 1 _____
Colony 2 _____
Colony 3 _____
Colony 4 _____
Colony 5 _____

Observations

1. Which side of the Petri dish contained the highest number of microbes?

2. Which side of the Petri dish contained the most different colonies of microbes?

3. How many different colony types were there on the:

Clean section _____

Dirty section _____



Conclusions

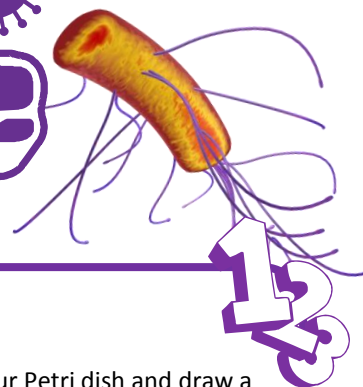
1. Some people may see more microbes on the clean side of the Petri dish than the dirty side. Why?

2. Which colonies would you consider to be the friendly microbes and why?





HAND HYGIENE



Procedure

1. Carry out the experiment according to the teacher's instructions.
2. In the table below, fill in how many different types of colonies you counted on your Petri dish and draw a graph of your results.

Results

	After washing (or not washing) and shaking hands					
	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
No wash (control)						
Quick wash						
Thorough wash						
Thorough wash w/ soap						

Conclusion

1. Which method of hand washing eliminated the most microbes?

2. Why would soap help eliminate more microbes than washing with water alone?

3. What are the advantages and disadvantages to using antibacterial soap when washing your hands?
Advantages: _____

Disadvantages: _____

4. What evidence do you have that microbes can be transmitted by hands?

5. Which areas of the hand would do you think would contain the most microbes and why?

6. List 5 times when it is important to wash your hands
 - a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____

