COMMONWEALTH CLASS

Emerging Infectious Diseases

In collaboration with

BRITISH COUNCIL

THE ROYAL SOCIETY

The Commonwealth

Introduction

Commonwealth Values: Access to health, education, food and shelter; Importance of young people in the Commonwealth

Curriculum links: Science; personal, social and health education; mathematics; art and design; citizenship; history

Core skills: Critical thinking and problem solving; Creativity and imagination; Citizenship; Digital literacy

Over the past century unprecedented gains in the prevention, diagnosis and treatment of disease have allowed people to live longer and healthier lives. But our health and wellbeing is now being challenged by the emergence of diseases that are resistant to antimicrobial drugs and new infectious diseases that spread quickly in our increasingly connected world.

Global responses are necessary to tackle the emergence of new threats, contain outbreaks and coordinate efforts to ensure people have access to healthcare and that current treatments remain effective.

One of the UN's Sustainable Development Goals is to ensure healthy lives and promote wellbeing for all ages.

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OVERVIEW

Why is it important?

As populations grow and people travel more, there is also a growing risk from new and emerging infectious diseases like bird flu, SARS and Ebola. If a disease is not identified early, the spread of disease can occur more quickly as people travel further and can pass the disease on to more people. It is therefore key for countries and global authorities, such as the World Health Organization, to work together closely to be better prepared for outbreaks of disease.

Scientific background to the problem

Diseases have a number of different ways of travelling from one person to another. There are ways of stopping or slowing the spread if you understand how each disease moves. Diseases can be carried in water or food, they can be transmitted by insects or animals, and they can be spread from one person to another by contact with blood or saliva. However, no matter how careful people are, it is very difficult to stop the spread of some diseases, particularly those which are air-borne or carried by animals and insects.

The immune system includes a series of specialised cells (white blood cells) that can recognise bacteria and viruses that cause diseases. When a microorganism enters the body, the immune system cells react to destroy the infection. Part of this reaction includes developing a 'memory' for that particular microorganism. If it is encountered again in the future, the immune system responds rapidly and prevents the infection from taking hold. The body has now gained immunity against the disease. This is the same process that is stimulated when a vaccination is given.

The vaccination against a particular disease contains a weakened or inactive form of the disease causing microbe, or just one part of it, that the immune system can recognise it by. The vaccination is unable to cause the infection but it does stimulate the immune system to respond and build up a memory for that disease. Future infections by live microorganisms of that type are then prevented.

A population can be given 'herd immunity' when around 85% of all people are immune to a disease and the disease is unlikely to be passed on if one person gets infected. Some people cannot receive vaccinations either because they have an immune system disorder or have received an organ transplant. With enough people vaccinated to produce 'herd immunity', those people who can't receive the vaccine are also protected. It is very unlikely that the disease will reach them and eventually the disease dies out.

However, some diseases may be caused by many different versions of the microbe. This means a vaccine will only be effective against the version it was designed for and may not work against a modified version. The microbes which cause diseases are able to mutate and change, which can make it both harder to identify what is causing the disease initially and how to treat it.

People are increasingly being infected with disease causing microbes that are resistant to the drugs used to treat them, such as antibiotics, meaning the infection cannot be easily cured. This is most common in hospitals where a higher number of drugs are administered. This can make it difficult for hospitals to treat people as the infections can prevent or complicate other treatment that the patient may need, like surgery.

A more considered approach to the use and development of current and future drugs is needed in order to ensure that these drugs remain effective for longer. For the general population, it is crucial to follow the instructions given with the drugs and ensure the course of drugs is followed to the end as prescribed.

Possible solutions

Good surveillance and monitoring schemes are vital to the early detection of a possible epidemic. For example, the World Health Organization monitors worldwide influenza incidence and many governments carry out monitoring for their countries. Data gathering and data sharing allows identification of higher than usual rates of disease. This is so that action can be taken early if there are a lot cases, which may signal an 'outbreak', or if a large number of people are infected, an epidemic.

Early diagnosis can be harder in the case of new diseases, where the symptoms are not known. Cases presenting with unusual symptoms may not be linked together, particularly if located in different areas. New diseases will also not have any suitable vaccines to help prevent the spread.

When dealing with a lot of people infected all over the world, a situation that is described as a pandemic, the availability of a vaccine can be a critical element in preventing further infections.

With current production methods, it is estimated that it takes seven to nine months before initial doses of a vaccine are available. The regulatory agencies have a part to play in ensuring that, in an emergency, vaccines can be produced and licensed safely and without delay.

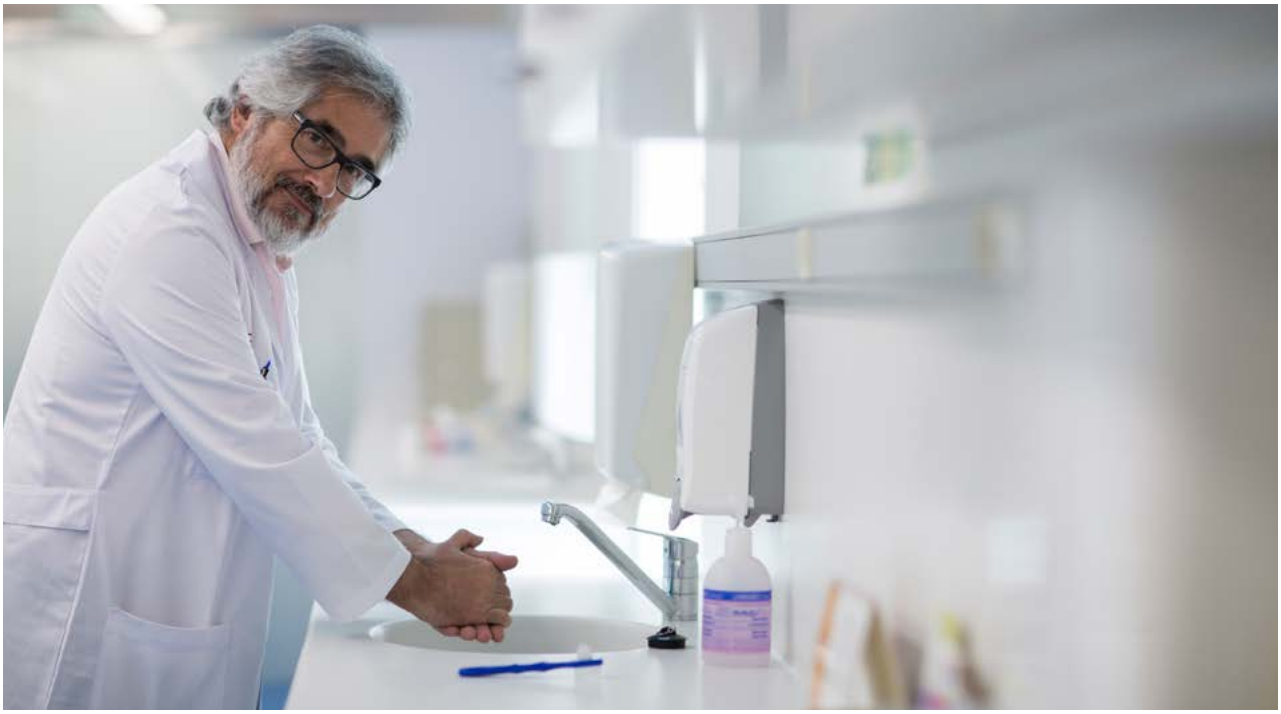
Drugs can also be useful in dealing with epidemics or pandemics. Antibiotics have been developed to combat bacterial infections and are often very effective when used correctly. There are few successful antiviruses. Treatment with drugs is expected to shorten the duration of the disease, alleviate symptoms and reduce complications and serious illness. However, there needs to be a method of getting the drugs quickly to the affected areas.

Along with vaccines and drugs, one of the key methods of preventing the spread of an infection is to make sure people do things like wearing protective clothing, avoiding contact with those who are sick, and disposing of contaminated objects appropriately. There are known as 'infection control' methods. These measures may help prevent the spread of disease in hospitals and community settings.

In order to be effective, this advice needs to be communicated to healthcare workers and the public. It should include:

- the value, if any, of personal protective equipment (such as face masks)
- protocols for hand washing
- disinfection routines for hospitals
- information on the isolation of 'known infected' and 'not known to be infected' individuals, hospital wards or residential homes.

Such non-pharmaceutical interventions may be the only measures available for many countries in a pandemic. These measures can be highly effective but require correct and rigorous adherence to protocols to work, which can be difficult in practice.



ACTIVITY 1: WHEN IS INFLUENZA MOST COMMON?

Overview

This is a research activity to investigate how common influenza is in different countries at different times of the year. Students should ideally research online as well as ask questions and share their findings with schools in other countries.

Activity

Influenza is a common disease in many parts of the world, with a number of different strains caused by slightly different microbes. New strains occur all the time and the World Health Organization keep a constant watch on influenza numbers to try and minimise the risk of a pandemic outbreak.

Graphs of influenza cases in Australia and Canada over the course of one year can be found in Appendix A - you may want to print and hand these out to your class.

The countries are similar in terms of socioeconomic background.

Students should compare the two graphs and consider the differences. Points to consider might include:

- What is the maximum number of cases in a week in each country? Note that the scale on the y-axis of the two graphs is very different and discuss the difference that makes when reading the graphs.
- Why are there different total numbers? Compare the populations of the country, how people are distributed across the country and the weather conditions.
- Which is the most common strain of influenza in each country? Does the proportion of each strain of influenza remain constant over the year?
- When is influenza most common in each country? What month is that?
- Why do you think that might be?

Extension

If you have internet access, visit the World Health Organization FluNet and view the charts by country, area or territory to see what the pattern is in your country. You can compare with both neighbouring countries and countries far away.

Sharing your results

Results should be shared and discussed with other countries via the teacher forum on Schools Online or through your links with partner schools.

ACTIVITY 2A & 2B: COUGHS & SNEEZES SPREAD DISEASES

ACTIVITY 2A

Overview

This activity encourages students to investigate how diseases can spread.

Learning objectives

Some infections affect the lungs (chest) and so it is not unreasonable to link the spread of an infection by droplets in sneezes. This activity asks students to model the spread of droplets from a sneeze and investigating how far the germs might travel.

Activity

Organise students into small groups for the investigation. Give each group a copy of Appendix B with instructions and equipment to carry out their investigation.

Ask them to think about and discuss the following questions after their experiment:

- How could we reduce the spread of germs when we sneeze?
- How could you measure how many droplets are spread by each sneeze?
- Was your sneeze experiment perfect?
- What could you improve next time?

After sharing their results in the classroom, compare with those produced at other schools. How similar are they? What might have caused any differences?

Note: Diseases are often spread by more than one method and those spread by coughs and sneezes are usually also spread by contact.

Extension exercise

Stand at the front of the classroom, with a water spray bottle. Spray the bottle from close to your nose and show the children a 'sneeze.' Whoever was touched by a droplet of water is now 'infected' and stands up. Those students then spray the water bottle from close to their nose, showing a sneeze. Each child who is infected must continue to show how the virus spreads.

ACTIVITY 2B

Overview

This activity mimics the spread of diseases in a classroom. The students may appreciate a short demonstration of the activity with a few students before they start. Give students a copy of Appendix C with the instructions.

Activity

1. Start with one person: this is the first infected person. You can do this by handing out a piece of paper to each person with the word 'infected' or 'clear' written at the top of it. Do not tell the class who is infected.
2. Ask your class to walk around the room and chat with one another. It is best if they only speak to one person at a time. When they stop to talk to someone they must shake hands and show each other their piece of paper.
3. If a person meets someone with the word 'infected' on their paper they too become infected. Each person needs to write down whether they are still 'clear' or if they have become 'infected' on the next line of their paper. It is really important that they don't give away that they are infected because in reality they wouldn't know.
4. Your class can then carry on chatting to other people, each time showing the person the bottom line of their paper and writing down whether they are still 'clear', still 'infected', or whether they have become 'infected'. You can get them to move around randomly, when they feel like moving, or ask them all to change at the same time.
5. Once the infected people have shaken hands with or 'infected' two or three people, they will start to show 'symptoms' and can sit down. No-one will want to shake hands with them knowing they will be infected.
6. Pretty quickly you will find that the whole class will be sitting down, depending on how many times infected people shake hands with already infected people. You can stop the activity at any time, after they have each met 2 people, 3 people, or until they are all infected and sitting down.
7. If there are still some people standing you can then find out if they are infected. Has anyone survived the contagion?
8. You may then want to get them to wash their hands, so they don't really spread any colds throughout the entire class!

Extension options:

Changing the infectious period
You can mimic how diseases spread with both long and short infectious periods. Diseases which are contagious for a long while without showing symptoms, like chickenpox, spread more readily. Allow people to shake hands with ten people before sitting down. They may all spend a long time standing, but quite rapidly the entire class will be infected.

Make people more hygienic
You can also change the pattern of the spread by changing the behaviour of the people. Give pupils the choice of shaking hands with other people. If they don't want to shake hands (or in reality they wash their hands a lot) they are less likely to catch the disease.

'Vaccinate' some of the class
When you choose the person to be infected, also choose some people to be vaccinated against the disease. These people cannot be infected or spread the disease. Experiment with different numbers of vaccinated students.

Plotting it out
You can create a graph of how many people are infected at each stage of this experiment. The difficult bit is doing it so no one finds out who is infected! You can draw tables for all your variations, including vaccinated people and plot out the graphs.

How did it feel?
Ask students to discuss how it felt when they saw what was on their piece of paper. How did it make them feel about and how did they react to others?

This exercise is adapted from a Royal Society resource set called Invigorate.

Still from 'How do we stop infectious diseases from spreading' a film resource created with the Royal Society.

ACTIVITY 3A & 3B: HOW EFFECTIVELY DO YOU WASH YOUR HANDS?

ACTIVITY 3A

Overview

Students will investigate how washing their hands can reduce the spread of disease.

Activity

Give your students a copy of Appendix D. Place a small ball into some Vaseline or other oil based substance (e.g. butter) and then cover it with glitter. Describe that the glitter represents germs. Pass the ball around a circle and explore how germs (glitter) get passed from one person to another. If you do not have glitter available, you could use sand or coloured powder.

Students should then be split into three groups. Each group will nominate one person to have their hand covered in glitter and Vaseline to represent germs on their hands. Depending on their group, these students then perform one each of the following activities:

a. no hand washing

b. wash hands in water

c. wash hands in water and soap.

Once finished, each student returns to the group where they shake hands with the person behind them. The second person shakes hand with the third, and so on. Ask students to record what has happened.

Questions for discussion include:

- What was the most effective washing process?
- Why do you think that was?
- What happened when you shook hands with the person behind you?

Sharing your results

Share your results and ideas with other schools in your country and around the world.

ACTIVITY 3B
Overview

If you are able to access agar and petri dishes, you can also carry out the following experiment, which looks at the actual microbes growing from what students have on their hands. Give your students a copy a copy of Appendix E with the instructions on.

Activity

1. Divide the class into 4 even groups of students (A, B, C and 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 including door handles, sink taps, shoes, etc. The aim is to pick up lots of microbes.
3. Ask students to stand in four rows one behind the other and designate groups as follows:
   a. no hand washing
   b. wash hands in warm water very quickly
   c. wash hand in warm water thoroughly
   d. wash hands in warm water and soap thoroughly.
4. Provide each student in the class with two nutrient agar plates.
5. Each student should put a hand print on one of their agar plates and label clearly with their name and the stage of the experiment.
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 agar plate and again label it clearly with their name, the stage of the experiment, which group they were in and which number in line they were.
8. Place the nutrient agar plates in a warm dry place for 48 hours. Ask students to view and record their results.

Questions for discussion include:

- Which method of hand washing eliminated the most microbes?
- Why would soap help eliminate more microbes than washing with water alone? 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.
- What results did they find the most surprising?
- Where might the microbes on their hands 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.
- What are the advantages and disadvantages to using antibacterial soap when washing your hands?
- What evidence do you have that microbes can be transmitted by hands?
- Which areas of the hand would do you think would contain the most microbes and why?

This activity is adapted from a resource by eBug called Hand Hygiene.

CROSS-CURRICULAR ACTIVITIES

Overview

Governments and health agencies have encouraged messages about infection control using posters, radio and television adverts for many years. In the 2014-16 Ebola outbreak in West Africa, community radio stations and local singers used songs and jingles to help to spread information about the importance of good hygiene practices and infection control.

Activity

Divide your pupils into small groups and give them copies of the posters on Appendix F, and questions to discuss about the effectiveness of the messages conveyed by the posters. You could ask them:

- What is the key idea behind each poster?
- Describe the language, layout, and use of images.
- Who do you think it is aimed at?
- Which do you think is the most persuasive and effective poster? Give your reasons.
- What do you think would be the most effective ways to spread messages about health and hygiene to young people today?

Now ask your students to design and create their own posters, adverts or jingles to promote good respiratory and/or hand hygiene practices to prevent the spread of infection. They will need to think carefully about who their campaign is aimed at and how to present their ideas creatively and effectively, perhaps with a catchy informative slogan. Encourage them to share their results with each other and other classes across the school.

CROSS-CURRICULAR ACTIVITIES

Other activities

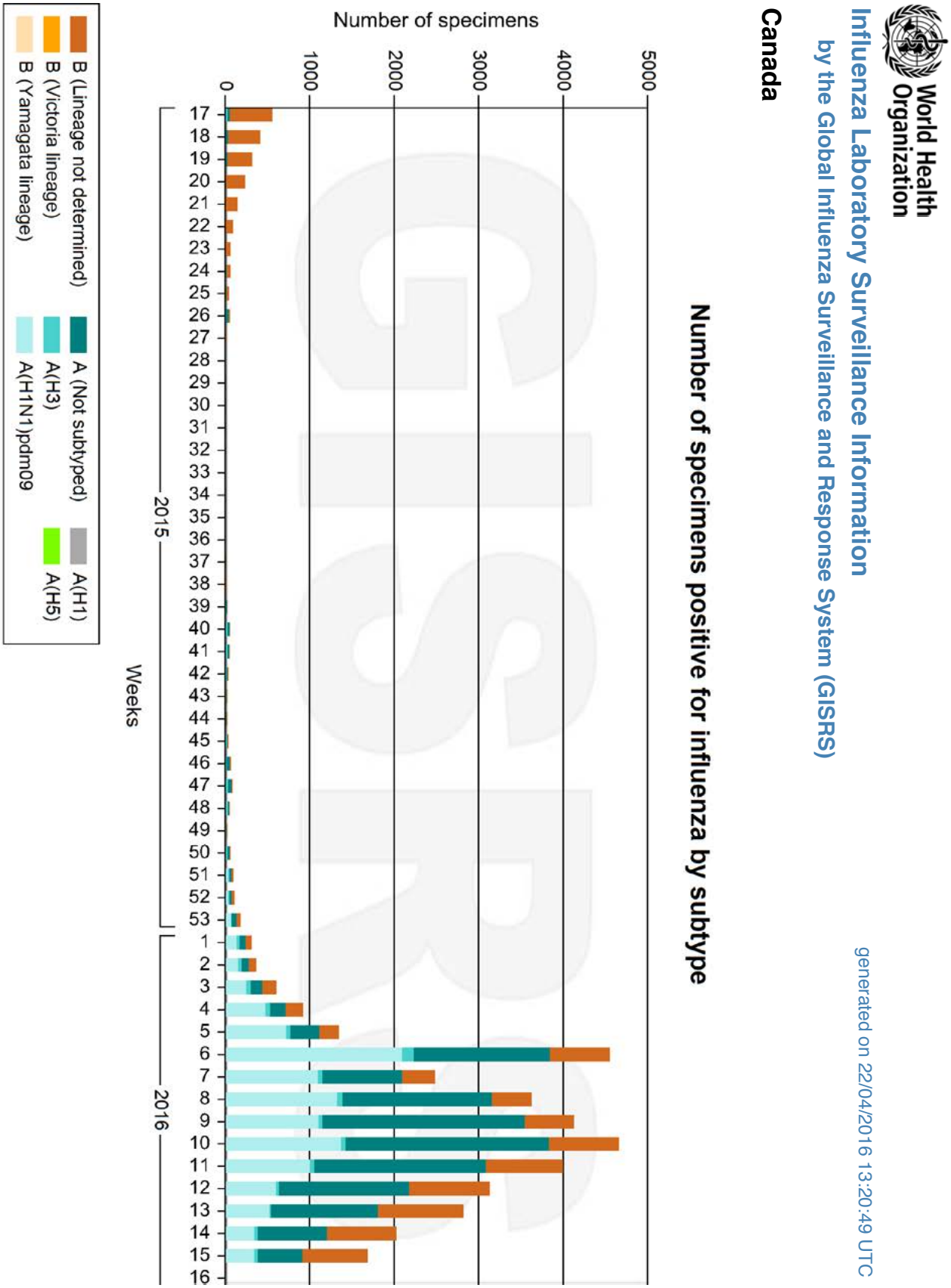
- You could also ask your students to draft a letter to the chief executive of a tissue company to inform them about your sneeze experiment findings. Explain what you did and what you discovered. Recommend how they might improve their tissue design and packaging, perhaps with a design or message about infection control.
- Research by scientists such as Dr. Donald Palmer is helping to continue to shed light on how the immune system responds to disease. Watch the video Inspiring Scientists: Donald Palmer's story of his life and career from a Royal Society resource set called Inspiring Scientists.
- Ask your students to find out about the lives and work of other scientists who advanced our knowledge and understanding of infectious diseases in the past. They might carry out research about Edward Jenner, an English country doctor who introduced the vaccine for smallpox, the French chemist Louis Pasteur who developed germ theory, or Alexander Fleming who discovered penicillin.

If you are working with a partner school you could:

- Share the findings of your experiments.
- Exchange your posters or jingles. Which do you think were the most effective? Why?
- Swap your research about scientists who advanced knowledge in this field and ideas on how to spread messages about stopping the spread of infections to young people in your countries today.

APPENDICES

Appendix A: when is influenza most common?



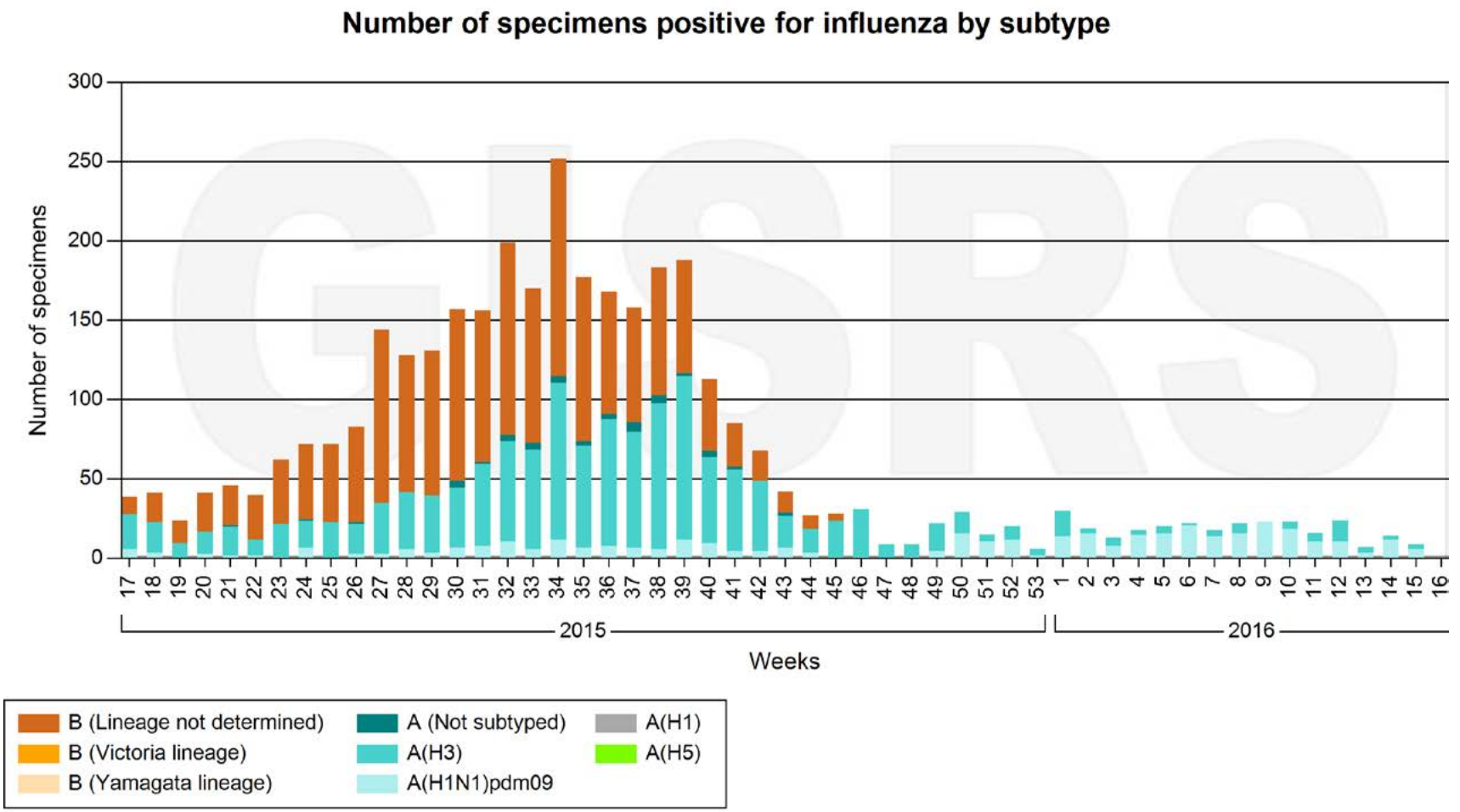
World Health Organization

Influenza Laboratory Surveillance Information

by the Global Influenza Surveillance and Response System (GISRS)

generated on 22/04/2016 13:30:48 UTC

Australia



Data source: FluNet (www.who.int/flunet), GISRS

Appendix B: Coughs and Sneezes Spread Diseases Activity Sheet 1

When you become ill, your illness sometimes makes you cough and sneeze. Coughs and sneezes contain droplets of fluid which also contain germs that can infect other people. How far can the germs travel?

Equipment:

- water
- spray bottle
- dye (optional to change the colour of water)
- A3 or A2 white paper
- rulers
- tissues.

Instructions:

1. Take a piece of A3 or A2 paper and put it flat on your table.
2. Take a water spray (including the dye if available) and hold it a certain distance from the paper (about 20cm).
3. Spray the water once and observe your paper.
4. Measure how many droplets of water have come from your 'sneeze'? Are you surprised how far your sneeze has travelled?
5. Write up your sneeze experiment method (what you did) and illustrate with a diagram.
6. Now try and answer the following questions:
   a. How could we reduce spread of germs when we sneeze?
   b. How could you measure how many droplets are spread by each sneeze?
   c. Was your sneeze experiment perfect?
   d. What could you improve next time?

Appendix C: Coughs and Sneezes Spread Diseases Activity Sheet 2

When you are ill you can pass the infection on to others in different ways, for example by touching them or breathing on them. Often you pass on the infection before you even know you are ill yourself. How quickly can an infection spread?

Equipment:

- A piece of paper
- A clipboard (optional)
- A pen or pencil

Instructions:

1. You will be given a piece of paper with the word 'clear' or 'infected' at the top. If you are infected it means you have a horrible disease!
2. Move around the class and stop and talk to someone. Shake their hand and show them your piece of paper but try to keep it secret from other people you haven't spoken to yet. (In reality you wouldn't even know yourself if you were infected).
3. If you or the person you meet has the word 'infected' on their paper, write 'infected' on the next line of your paper. If you are both 'clear', write 'clear'.
4. Move on to another person and repeat steps 2 and 3. Once infected you will infect others! Continue to write 'infected' on the next line of your paper until you have infected a certain number of people (your teacher will tell you how many). Once you have infected this number of people you will start to show symptoms and can quarantine yourself at the side of the room. After all, no one will want to talk to you now they know you are clearly ill.
5. Watch as the number of infected students grows. Has anyone in your class managed to escape this horrible disease?

Still from 'How do we stop infectious diseases from spreading?' a film resource created with the Royal Society.

Appendix D: How effectively do you wash your hands? Activity Sheet 1

Equipment:

- Glitter, or similar coloured powder
- Vaseline, or similar oil based substance
- Water
- Soap
- 2x sink or washing up bowl.

Instructions:

1. You will be split into three groups (A, B and C).
2. One of you must volunteer to catch the 'disease'. This student must cover their hands with Vaseline and dip it in the glitter
3. The student with the 'disease' should perform the following action depending on their group:
   a. no hand washing
   b. wash hands with water only
   c. wash hands with water and soap.
4. The student with the 'disease' should then return to the group and shake the hand of the next person in line.
5. That student should then shake the hand of the person next to them and continue this throughout the group.
6. Compare with the other groups how far the glitter has spread.

Note: remember to shake hands using the same hand each time.

Extension

You could try using different types of soap and compare how effective they are.

Appendix E: How effectively do you wash your hands? Activity Sheet 2

Equipment:

- 2x nutrient agar plates per student
- Water
- Soap
- 3x sink or washing up bowl

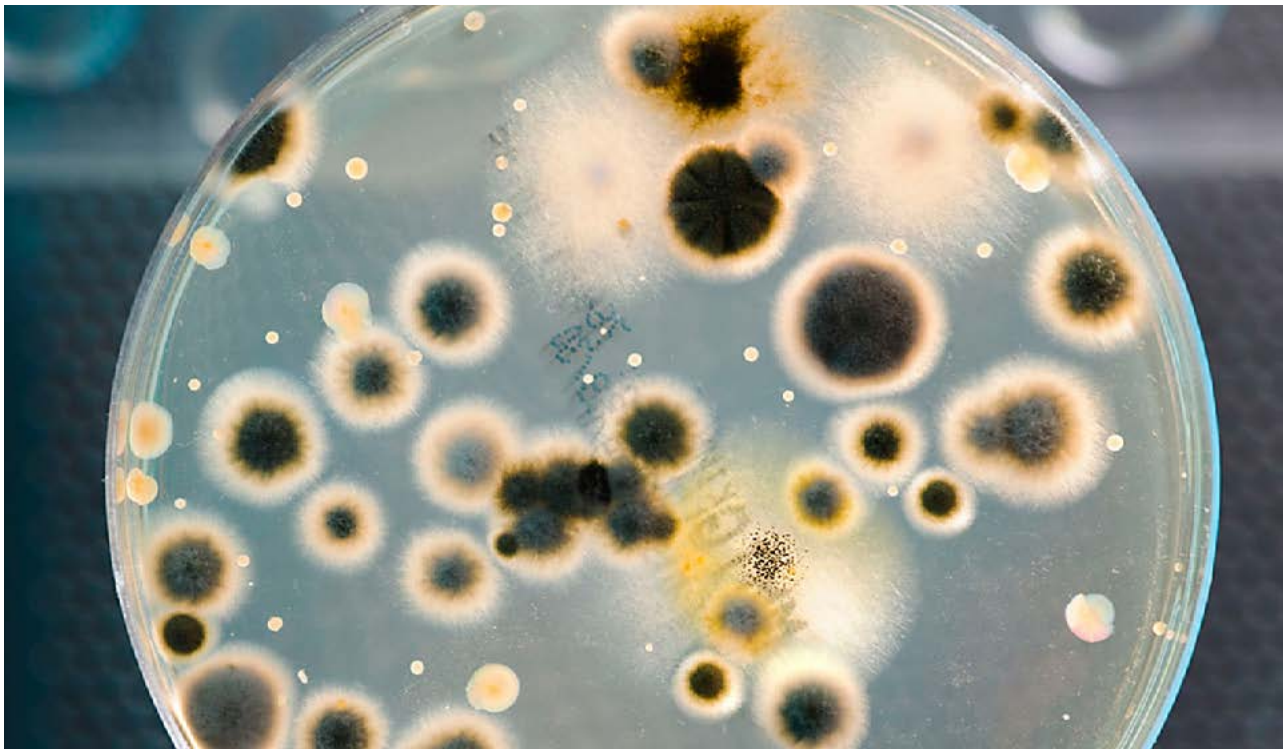
Instructions:

1. You will be split into four groups – A, B, C and D
2. A lead student in each group will touch as many things around the room as possible, e.g. doorknobs, table tops, food. All other students should wash their hands thoroughly with soap and warm water.
3. All students put a handprint on their first agar plate.
4. The lead student should perform the following action depending on their group:
   a. No hand washing
   b. Dip hands quickly in warm water
   c. Wash hands with warm water thoroughly
   d. Wash hands with warm water and soap.
5. The lead student with the 'disease' should then return to the group and shake the hand of the next person in line.
6. That student should then shake the hand of the person next to them and continue this throughout the group.
7. All students now put a handprint on their second agar plate.
8. Label the plates clearly and leave them in a warm environment for 48 hours before returning to examine the results.

Note: remember to shake hands using the same hand each time.

Extension

You could try using different types of soap and compare how effective they are.



Appendix F: Infection control posters

NHS

Coughs and sneezes spread diseases

always carry tissues

cover your coughs and sneezes

throw used tissues in a bin

always clean your hands

Stop germs spreading

CATCH IT

Germs spread easily. Always carry tissues and use them to catch your cough or sneeze.

BIN IT

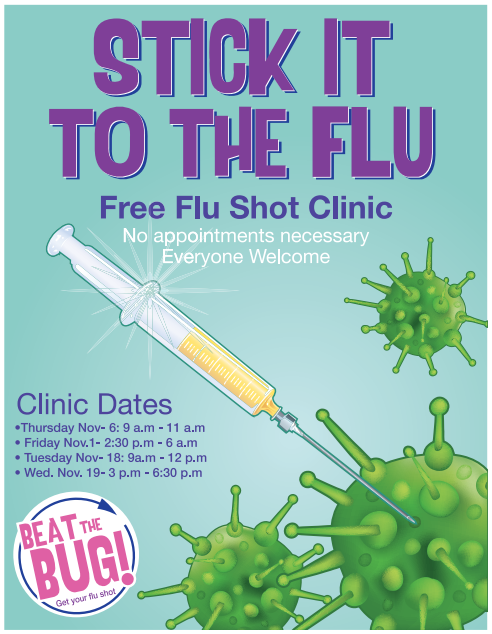
Germs can live for several hours on tissues. Dispose of your tissue as soon as possible.

KILL IT

Hands can transfer germs to every surface you touch. Clean your hands as soon as you can.

NHS


Stop
the Spread
of Germs
Stay Home
If You're Sick
Cover Your
Sneeze
Cover Your
Cough
SOAP
Wash Your Hands
With Soap & Water
dreamstime.com


STICK IT
TO THE FLU
Free Flu Shot Clinic
No appointments necessary
Everyone Welcome
Clinic Dates
•Thursday Nov- 6: 9 a.m - 11 a.m
• Friday Nov.1- 2:30 p.m - 6 a.m
• Tuesday Nov- 18: 9a.m - 12 p.m
• Wed. Nov. 19- 3 p.m - 6:30 p.m
BEAT THE BUG!
Get your flu shot


GET YOUR
FREE
FLU
VACCINE
WHILE SUPPLIES LAST
CLINIC DATES
November 1 - 10 am
November 2 - 10 am
November 3 - 10 am
2014
YOUR LOCAL DRUGSTORE: 123-456-7890
KNOCK OUT THE FLU!
STAY HEALTHY
GET THE SHOT
YOUR BEST DEFENSE

Find out more

Further activities and teacher resources

- Emerging Infections: Science for you to try: https://www.stem.org.uk/elibrary/resource/31885/emerging-infections-science-for-you-to-try
- eBug: http://www.e-bug.eu/
- Brought to Life: disease and epidemics: http://www.sciencemuseum.org.uk/broughttolife/themes/diseases

Further reading

- Royal Society, Pandemic influenza: science to policy: https://royalsociety.org/topics-policy/publications/2006/pandemic-influenza/
- The Academy of Medical Sciences, Prepare to conduct pandemic flu trials in hospitals now: http://www.acmedsci.ac.uk/more/news/prepare-to-conduct-pandemic-flu-trials-in-hospitals-now/
- UK flu map: https://flusurvey.org.uk/
- International flu map: http://www.who.int/influenza/surveillance_monitoring/updates/latest_update_GIP_surveillance/en/
- World Health Organization emergency capacity reforms: http://www.who.int/about/who_reform/emergency-capacities/en/