Microbes for minors

Winter is coming, bringing with it the increased likelihood of the spread of coughs and colds. It is now more important than ever to emphasise the importance of good hygiene, both in and out of the classroom. Currently there is an understandable focus on the coronavirus COVID-19 but there is so much more to find out about the often "secret" world of microbes.

Learning more about the fascinating subject of microbiology could support CfE Experiences & Outcomes and Benchmarks in the Sciences [1] as well as Health and Wellbeing [2]. Most learners are aware of "germs" – the generic term used to describe the microorganisms that cause disease, but how much is known about the different types of microbes that surround us? Microbes are all around us, on us and inside us! The microbes living within an average adult weigh around 1 kg – about the same as a bag of sugar.

The majority of microbes are far too small to see, but these microscopic organisms play a very important role in our lives. Some make us sick, but many more are helpful. In fact, many microbes are essential for keeping us healthy – helping us to digest our food, clearing up environmental waste, producing compost, oxygen and some foods including bread, cheese, pickles, salami, and soy sauce, as well as alcohol!

Figure 2 - Equipment for the "how many bacteria on a full stop" activity.

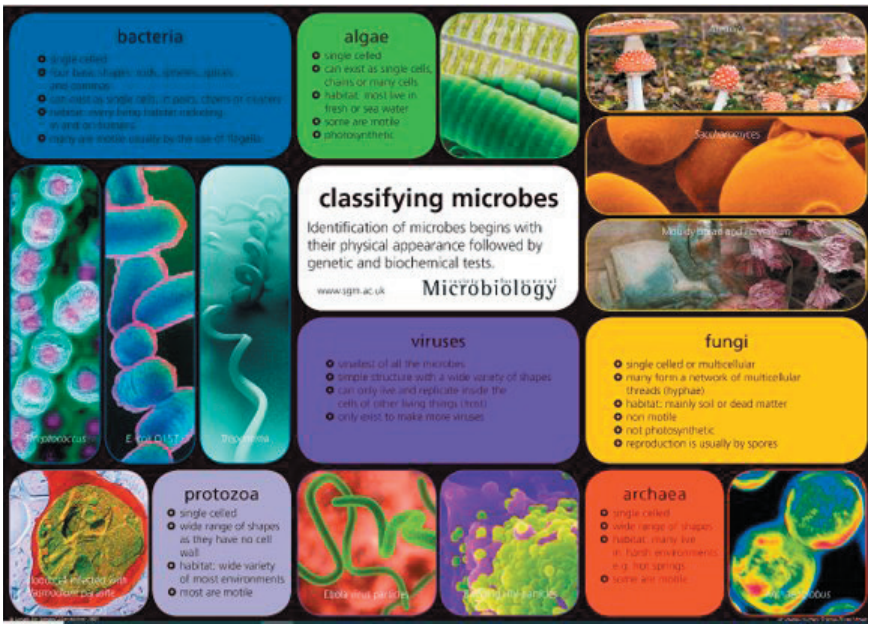

Figure 1 - Classifying microbes poster - from the Microbiology Society [3].

Microorganisms have a vast array of shapes, sizes and habitats are classified into six different groups (Figure 1):

- Bacteria
- Viruses
- Fungi
- Algae
- Protozoa
- Archaea

The Microbiology Society have produced some very useful on-line resources that are free to access – including an introduction to microbes [4], introduction to microbiology [5] and interactive microbe "passports" [6] where learners can find out more about the microbes that are all around us – friends and foes!

How many bacteria can fit on a full stop?

As most microorganisms are so very tiny it can often be difficult for learners to imagine the vast number of microbes that surround us. Finding a way of modelling some of the numbers and scale involved, in a way that learners can relate to, could help them get to grips with these concepts.

We are going to focus on bacteria for this activity, learners should be aware of differences in the sizes of microorganisms and methods of microbe reproduction.

We use a 54 cm diameter hoop (the kind found in most primary schools) to represent the greatly enlarged full stop. Standard plastic counters (or tiddly winks) are used to represent the bacteria (Figure 2). >>

Figure 3 - Completed "how many bacteria on a full stop" activity.

Figure 4 - Cardboard box and fragranced oil.

Learners are asked to estimate how many of the "bacteria" they think could fit on the area covered by the "full stop" and make a note of this. We package the counters up into bags of 20 before the activity – this makes it much easier to work out how many counters have been used to cover the area of the hoop (Figure 3).

We have made a short video to demonstrate the activity – this is available to view on SSERC TV [7].

It is worth noting that on this scale the counters represent large bacteria. Learners could research and compare the different sizes of microbes and find out how bacteria reproduce in real life.

Coughs and sneezes spread diseases

There are a few simple practical activities that demonstrate how far droplets from a cough or sneeze could spread. These droplets could contain pathogens (disease causing microbes) from the nose, mouth or lungs. Some viruses can live on hard surfaces for hours, under favourable conditions, with the possibility of transferring into a host in order to reproduce. Taking part in these activities demonstrates how important it is to cough or sneeze into the crook of your elbow or "catch it, bin it, kill it" in a tissue, wipe down surfaces and wash hands after coughing or sneezing.

Air-blaster cough

Using a study cardboard box and some fragranced oil or essence (Figure 4) it is possible to demonstrate how far a cough could travel. Seal the box up with tape and then cut out a circle (diameter between 10 cm-20 cm) from the centre of one of the shorter ends. Add a few drops of fragranced oil or essence to the inside of the box (check to make sure that there are no allergies to the fragrance/essence selected).

Point the open hole towards a group at least 2 m away and simultaneously "clap" both of the long sides of the box, with a hand on either side.

Anyone in the way of the simulated cough should quickly smell the fragrance – demonstrating how far air from the lungs can travel. Find a link to videos of the construction of the air-blaster [8] and a demonstration of how to use it [9] on SSERC TV.

Spray-a-sneeze

A plant spray bottle, water and food colouring can be used as an effective way to demonstrate how far droplets can be spread by an uncovered sneeze.

Add water to the bottle and set the plant spray nozzle to a fine mist. You could add a few drops of food colouring to the water if you wish, but beware that this may stain the surroundings. You may wish to take this activity outside!

Lay around 8 -10 pieces of flip-chart paper or a white paper tablecloth below the spray bottle. Holding the bottle, pull the trigger and allow the droplets to fall onto the paper below. Examine how far the droplets spread. You might like to try holding the bottle at different heights to investigate how far a standing person's droplets could travel compared to a seated person. Again, there is a video to accompany this activity on SSERC TV [10].

An internet search for slow-motion sneezes [11] will produce some incredible images – showing just how fast droplets leave the mouth and nose!

Why do we need to wash our hands?

Using a small amount of body glitter gel is an effective way to demonstrate just how quickly microbes can be spread from one person to another and also to emphasise how important effective hand-washing is in the fight against infection. >>

Figure 5 - Simple resources to model a sneeze spray.

Figure 6 - Body glitter gel - for glitter sneeze investigation.

Ensure that a hypoallergenic body glitter gel is used – do not use craft glitter as this can cause irritation if it gets into the eyes. A small squeeze of the gel onto a hand before undertaking tasks can be used to illustrate how microbes can spread from one person to another. Examine objects for "contamination" after a few minutes of normal activity e.g. writing with a pencil.

Learners can check their hands after washing to see if there is any glitter gel left between fingers, under finger-nails etc. and help to improve handwashing techniques. There is a video with examples of different tasks that could be undertaken, depending on your circumstances [12].

Figure 9 - Marvellous Microbes – microbiology comic strips from the Microbiology Society.

Microbes – vital for life

It is important to realise that less than 5% of microbes cause harm – the rest are either benign, useful or indeed vital to life as we know it. SSERC has published examples of practical activities that show the usefulness of microbes aimed at 2nd level learners. See Figure 7 investigations with yeast [13] and Figure 8 – compost cups [14]. Both activities provide opportunities for observation over time - the yeast investigation over the course of a school day and the compost cups over the course of a number of weeks.

Figure 7 - Investigations with yeast.

Figure 8 - Compost investigations.

The bigger picture - further ideas

Learners can research some of the scientists involved in microbiology and medicine, including Antoine Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, John Snow and Alexander Fleming.

Most people are aware of Fleming's famous discovery, which lead to the production of the antibiotic penicillin. Attention is now focused on the threat posed by antibiotic resistant bacteria, one of the biggest global health concerns and an important issue facing everyone today. To beat antibiotic resistance, we need to take antibiotics properly and understand what they can and cannot treat. The Microbiology Society has produced a number of Marvellous Microbes comic strip booklets (Figure 9) one of which explains antibiotic resistance [15].

Health and Safety Advice - Microbes

SSERC publishes the Safety in Microbiology: A Code of Practice for Scottish Schools and Colleges [16]. Most primary teachers will be carrying out work at covered by Level 1 of the code of practice, as set out in this code of practice. Work at Level 1 requires no specialist training or equipment. >>

CfE Experiences & Outcomes/Benchmarks

Body Systems and Cells

- I know the symptoms of some common diseases caused by germs. I can explain how they are spread and discuss how some methods of preventing and treating disease benefit society - *SCN 1-13a*.
- Describes the symptoms of some common diseases including colds, mumps, measles, chicken pox and flu.
- Provides explanations, supported by evidence, of how some diseases spread and discusses ways in which some diseases can be prevented through good hygiene and vaccination.

SSERC does not recommend growing microbes on agar plates/petri dishes in primary school settings as the preparation of sterile plates and disposal of cultured plates requires specialist knowledge and equipment. We occasionally find commercially produced kits that cause us concern – see Bacteria Farm, SSERC Bulletin 76 [17].

Contact SSERC for help and advice primary@sserc.scot.

CfE Experiences & Outcomes/ Benchmarks

Body Systems and Cells

- I have contributed to investigations into the role of microorganisms in producing and breaking down some materials - *SCN 2-13a.*
- Demonstrates understanding of how microorganisms, including bacteria, viruses and fungi, can multiply rapidly.
- Investigates and explains the action of some microorganisms used in food production, for example, yeast in bread and bacteria in yoghurt.
- Describes how some micro-organisms break down food causing it to be inedible or harmful if digested, and how others exist in the gut to break down food to aid digestion.
- Investigates, observes and records how microscopic organisms are necessary for the process of decomposition (the breaking down of dead material – decay).

CfE Experiences & Outcomes/Benchmarks

Topical Science

- Through research and discussion, I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society - *CN 2-20a*.
- I can report and comment on current scientific news items to develop my knowledge and understanding of topical science - *SCN 2-20b*.
- Researches historic and contemporary scientists (ensuring gender balance) and their scientific discoveries and reports collaboratively to others using a range of methods.
- Describes the impact of scientific discovery, creativity and invention on society past and present, for example, in design, medicine and agriculture.
- Demonstrates understanding of how science impacts on every aspect of our lives.
- Relates the development of scientific skills in the classroom to an increasingly wide variety of science, technology, engineering and mathematics (STEM) careers.

References

[1] https://education.gov.scot/nih/Documents/SciencesBenchmarksPDF.pdf.
[2] https://education.gov.scot/nih/Documents/HWBFoodHealthBenchmarksPDF.pdf.
[3] https://tinyurl.com/y2k7g9ms.
[4] https://microbiologyonline.org/index.php/about-microbiology/introducing-microbes.
[5] https://microbiologyonline.org/index.php/about-microbiology.
[6] https://microbiologyonline.org/index.php/about-microbiology/microbe-passports.
[7] YouTube link available at https://youtu.be/t2jjJMSZ3sc.
[8] YouTube link available at https://youtu.be/H8e7f_gIMl8.
[9] YouTube link available at https://youtu.be/VxLKXIh-GWU.
[10] YouTube link available at https://youtu.be/nIBdGGZfpS8.
[11] Slow-mo sneeze link - https://www.youtube.com/watch?v=wnafrAtfMzE.
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[15] https://microbiologysociety.org/publication/education-outreach-resources/marvellous-microbes-using-antibiotics-issue-4.html.
[16] https://www.sserc.org.uk/wp-content/uploads/2018/06/SSERC-Safety_in_Microbiology_Code_of_Practice.pdf.
[17] https://www.sserc.org.uk/wp-content/uploads/2019/07/SSERCP76_web.pdf.

Other Microbiology Society resources

- https://microbiologysociety.org/publication/education-outreach-resources/marvellous-microbes-baking-bread-issue-1.html.
- https://microbiologysociety.org/publication/education-outreach-resources/marvellous-microbes-washing-hands-issue-2.html.
- https://microbiologysociety.org/publication/education-outreach-resources/marvellous-microbes-brushing-teeth-issue-3.html.
- http://meetthemicrobes.com/wp-content/uploads/2020/03/Meet-The-Microbes.pdf.

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