2. MONITORING MICROBES

1 HOUR PLUS A WEEK OF 10-MINUTE DAILY OBSERVATIONS OVER TWO WEEKS

Children dab their fingers onto agar plates before and after cleaning their hands, then grow their samples to observe how many bacteria are revealed. This is a skill building activity designed to prepare children for a more in-depth investigation in Activity 3 so please complete this first. If children are sufficiently skilled, this activity can be skipped.

This activity requires additional resources, preparation time, and access to suitable materials. If children are already confident in the relevant practical skills, it can be omitted. To help reduce costs or preparation demands, you may wish to work with a local secondary school science department, university, or local company, which may be able to provide materials, facilities, or advice.

TYPE OF ENQUIRY

Comparative test

OBJECTIVES

Plan different types of scientific enquiries to answer questions. (UKS2 Working Scientifically)

Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms.

(Y6 living things)

SCIENCE VOCABULARY

microbe, microorganism, bacteria, germ, clean, dirty, grow, nutrient, food source, living thing

RESOURCES

(per group of four, unless otherwise stated)

For the introductory activity:

- Access to soap and water for whole class handwashing
- Hand sanitiser (enough for the class to clean hands once)
- 3 sterile Petri dishes with agar solution (+1 Petri dish for class control sample)[3]
- tape for sealing Petri dishes e.g. medical tape[4]
- permanent marker pen or stickers to identify each person's fingerprint
- **Activity sheet 4, Activity Sheet 5** (optional)
- Protective gloves (if needed see safety guidance for further details)

3 20 disposable Petri dishes £3.00 from Philip Harris. 10 agar Petri dishes £19.72 exc. VAT from Breckland Scientific. Prices correct at time of publication. Alternatively, you can make your own, see guidance on page 18.

4 Medical tape is available from pharmacies or supermarket first-aid supply section

AGAR PLATES – ADVANCE PREPARATION GUIDANCE FOR TEACHERS

If purchasing pre-made agar plates:

- Check the supplier's advice on shelf life, this can differ significantly.
- Check storage requirements, some require refrigeration whilst others advise against it.

A lower cost alternative to buying agar plates is to make your own. This is a straightforward process but you will need to factor in the following:

- Time is required to prepare these in advance.
- Care is needed to ensure plates remain sterile throughout the preparation process.

To make approximately 30 agar plates, you will need:

Equipment	Ingredients
Anti-bacterial surface cleaner and cleaning cloth Microwave Kettle Microwave-safe glass measuring jug 30 sterile petri dishes Cling film	900 ml boiled water 3 tsp agar agar powder ½ plain beef stock cube 1 tsp sugar

INSTRUCTIONS:

Use an anti-bacterial surface cleaner to prepare a clean surface big enough to lay out enough petri dishes to make your planned number of agar plates.

Microwave the microwave-safe glass measuring jug (2 minutes) to sterilize.

Pour the boiled water into the glass jug. Add the agar agar powder, plain beef stock cube, and sugar to the jug. Stir until completely dissolved.

Place the agar mixture into the microwave (full power, 2 minutes). Keep a close eye on the mixture to make sure it does not boil over.

Let the mixture cool for 1 minute before removing it from the microwave. Take extra care when removing, the bowl and agar mixture will be hot.

Pour the mixture into the petri dishes and cover with clingfilm to prevent any germs from the surrounding area getting into the cooling mixture.

Leave the mixture for 1hr to cool and solidify.

Check the mixture has cooled fully before removing the cling film and placing the lid onto the dishes. Do not put the lids on until the mixture has cooled, this will cause condensation to become trapped, making observation difficult.

NOTE:

Time to make: 20 minutes + 1 hour cooling time

Agar plates can be stored for up to 4 weeks in a refrigerator at 4°C until ready for use.

Homemade agar plates work just as well as factory-made plates but may look different, as the colour and surface texture can vary.

SAFETY GUIDANCE

The agar solution is safe to touch. Children with skin sensitivities should wear protective gloves for this activity and wear them for a short while prior to doing the finger dab to enable exposure to microbes. Over a break or lunch time would work well.

Some agar powder packages are labelled 'may contain traces of nuts' so please check the packaging carefully.

Once sealed, Petri dishes **MUST NOT** be reopened. Growing microorganisms releases invisible spores and can lead to respiratory irritation. The dishes should be disposed of in their sealed condition at the end of the investigation.

CLEAPSS recommend carrying out activities using agar plates with support from a secondary school partner for safe disposal. For more information, please visit the CLEAPSS website and search for the term 'agar plates'.

PRIOR KNOWLEDGE/EXPERIENCE

Children will have some experience of setting up simple practical enquiries and comparative tests.

ACTIVITY NOTES

Revisit the letter from the company scientist **(Activity Sheet 4)** and explain that Synthomer use regular testing to keep their ingredients free from infection caused by bacteria, a group of tiny living things known as microorganisms. It is important that Synthomer keep their ingredients infection free so they are safe for their customers to use and they don't have to throw away infected products, like we might throw away mouldy bread.

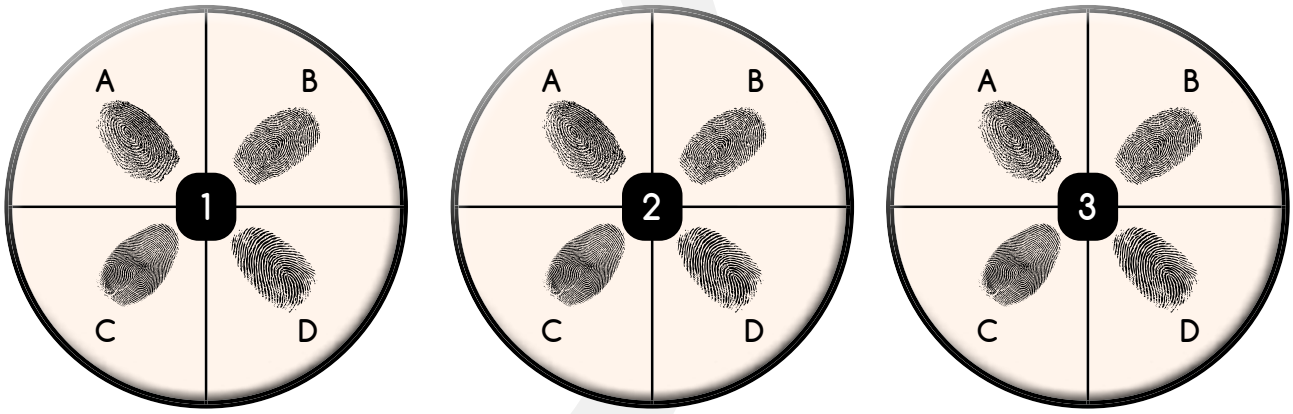
Children will prepare for Activity 3 by carrying out a finger dab test and learning how to monitor microbe growth using an agar plate. When bacteria grow on the plates, they form small spots called colonies which make the otherwise invisible bacteria easier to observe and compare.

A control agar plate should be set-up which children use for comparison; a sterile Petri dish containing agar solution which is sealed without coming into contact with any other surfaces.

In groups, children use a sticker or permanent marker to indicate where they will place their fingerprint on the base of three agar plates as follows:

- Plate 1 – Unwashed hands
- Plate 2 – Hands then washed with soap and water
- Plate 3 – Hands then cleaned with hand sanitiser

Each child will place a fingerprint in each of the three plates. They should use the same finger to place their print in each of the agar plates.



Unwashed hands

Hands washed with soap and water

Hands washed with hand sanitiser

Place the lids on the Petri dishes and seal with tape. Leave the agar plates to develop in a dark place at room temperature (20-25°C). Microbe growth should be visible after 2-3 days.

Over the next fortnight, take approximately ten minutes each day to monitor the agar plates. A photo or sketch diary would enable children to compare the plates based on microbe growth. **Activity Sheet 5** can be used for this purpose, or children can create their own record, e.g. counting the number of individual microbe colonies they can see to generate numerical data for comparison.

Observations are likely to reveal that different types of microbes are present. Children may notice that they have grown microbe colonies which differ in size, colour, and number. They may also see that colonies can grow at different speeds; some spread out and cover the plate, perhaps merging with other colonies, whilst others remain isolated and small. These differences occur because different types of bacteria will be growing and like other living things, different species behave differently.

The **Questions for thinking** (below) support the development of children's higher order thinking skills. The information provided below is included to provide support in scaffolding children's responses:

Microbes grow on agar plates because agar is a jelly-like substance that contains water and nutrients, which gives tiny living things such as bacteria and fungi the food and moisture they need to multiply. As they reproduce, they form visible groups called colonies. These colonies can be different colours, such as white, cream, yellow, orange, pink or even green, depending on the type of microbe. Different growth patterns can often be observed on different agar plates because the microbes that land on them come from different places, for example, hands before washing, hands after washing, or surfaces around the classroom.

Cleaning hands with soap or using hand sanitiser usually reduces the number of microbes, so fewer colonies are likely to grow on the agar. Colonies can also be different shapes and sizes; some may be small and round, while others may spread out in fuzzy or uneven patterns. Some microbes grow faster than others because they have different needs and life cycles. To find out the names of the microbes, scientists would need to carry out further investigations in a laboratory, such as using microscopes, special tests, or comparing them with known samples, as this cannot be done just by looking at the agar plate.

TOP TIPS

Some of the bacteria growing can be similar in appearance to mould, which children may be more familiar with. To avoid future misconceptions, a short conversation around the differences between bacteria and mould will support children to recap (or introduce them to) grouping and classifying microorganisms in their year 6 living things topic. Bacteria are simple living things which can live on their own and grow by splitting in two. Some are helpful (like bacteria in the stomach) while others can make us ill. Mould is a type of fungus and grows in a network of fine threads; it spreads by releasing spores into the air.

QUESTIONS FOR THINKING

- Why do the microbes grow?
- Did all agar plates grow microbe colonies? Why?
- What conditions did you grow your microbe colonies in?
- What different colour colonies can you see?
- How many different microbe colonies are in each agar plate?
- Can you find similar growth patterns across different agar plates?
- Has cleaning hands with soap or using sanitiser reduced the number of microbes?
- Are the microbe colonies different shapes or sizes?
- Did some microbe colonies grow faster than others?
- How might scientists find out the name of different microbes?
- Background information

This information is to support the teacher's knowledge of the subject only. It should not be used in the classroom.

An agar plate is a shallow Petri dish filled with a jelly-like substance called agar which is made from seaweed. Agar gives microorganisms the nutrients and water needed to grow, and the plates are used by scientists to see what microorganisms are growing in different environments.

USING THE PRESENTATION

Ingredients which cause less harm to the environment, used by companies like Synthomer, are prone to infection caused by bacteria. Before Activity 2, share the slides to show how lab testing is carried out to ensure products are free from infection.

To conclude the lesson, use the STEM Careers slide at the end of the presentation to highlight real-world jobs in STEM to nurture children's science capital. Share Vaishali's career profile to inspire pupils by helping them make connections between their classroom learning and the science that is used in exciting jobs.

INDUSTRY LINKS AND AMBASSADORS

A scientist, university student who works in a lab setting, or secondary school biology lab technician would be an excellent choice of ambassador to visit the classroom to help you enrich this activity. They may be able to demonstrate some of the practices for ensuring clean working conditions in the lab and bring photographs and equipment to show children. Depending on their working environment, they may even be able to supply and grow the agar plates for you.

STEM CAREERS

Vaishali studied microbiology at university and has worked at many companies which make medicines. She works with very tiny living things which cannot be seen with the naked eye, so she uses a microscope to observe them. At Synthomer, Vaishali makes sure that the paints, glue, and gloves are infection free and safe to use. She helps to make the world a better and safer place by reducing the use of harmful ingredients in their products.