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Tips & Tools

Biofilms for Babies: Introducing Microbes and Biofilms to Preschool-Aged Children †

Jillian M. Couto
Division of Infrastructure and Environment, School of Engineering, University of Glasgow, Glasgow G12 8QQ, Scotland

INTRODUCTION

Life as we know it on Earth has become possible because of microbes that drive biogeochemical cycles. This ensures that the major building blocks that sustain life are kept in balance (1). Indeed, microbes are ubiquitous, and the power of their metabolisms has now been harnessed to drive processes in the built environment, for example, wastewater treatment in civil engineering and drug and chemical production by the biotechnology industry. They are also increasingly becoming the subject of research focused on their use in generating alterative sources of energy and as drivers of resource recovery from waste (2). A recent opportunity to speak to preschool-aged children (three to five years) about working as a scientist led to the development of this quick activity to introduce them to the ubiquity of microbes and the fact that they live in biofilms in the natural environment.

PROCEDURE

A recent article described an elegant way with which to present the concepts of microbes and biofilms from the oral microbiome to both school-aged children (9- to 12-year-olds) and adults, utilizing widely available craft and household items (3). The current work adapts this previous work for a younger age group of children, focusing on environmental biofilms. For the younger age group, attention had to be paid to preventing children from eating any small parts. Therefore the petri dishes containing the model microbes were sealed, and non-toxic materials, such as agar or jelly, were utilized.

Corresponding author. Mailing address: University of Glasgow, School of Engineering, Infrastructure and Environment, Rankine Building, Level 5, Glasgow, G12 8LT, Scotland. Phone: +44(0) 141 330 6311. E-mail: Jillian.Couto@glasgow.ac.uk.
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Materials

Staedtler FIMO Soft®
A basic microscope
10-cm petri dishes (or any plastic container with a clear lid)
Lab agar (commercially available as agar-agar; Jelly or gelatin sheets can be substituted)
Distilled water (or boiled tap water)
Lab PARAFILM® (or packing tape)
A series of pictures of microbes (Internet); Appendix 1

Pre-activity preparation

It should be noted that the pre-activity preparation is intended for and should be carried out by the adults (e.g., researchers or teachers) who will be leading the activity.

1. Model microbes were created in various shapes using FIMO polymer clay (Staedtler, Germany) (Fig. 1). N.B.: these are small parts, which could constitute a choking hazard and should not be handled by children unless they are supervised.
2. A basic microscope (Taote Toys Company, China) was used to introduce the children to the idea that small things can be viewed via special tools.
3. The model biofilm in a petri dish was constructed using some of the model microbes embedded in a gel, in a 10-cm plastic petri dish (Fig. 2). The microbes were gelled together using a solution of 2% agar (w/v). Briefly, the desired amount of agar and water were added into a glass container with a stir bar (optional), and melted in an autoclave for 20 minutes at 121°C. If the researcher is unable to access a lab for an autoclave, a microwave (eliminate the stir bar) can be used as a substitute. It should be noted that children should not be allowed to operate a microwave or an autoclave unsupervised. If using a microwave, heat on medium to high power until the agar powder is dissolved. Once melted, a few drops of food coloring were added and the mixture was stirred on a magnetic stir-plate. Once

the mixture was cooled sufficiently, it was poured into the petri dishes that already contained the desired model microbes and left to set. If a lab and agar are unavailable, a common dessert/snack jelly or gelatin sheets available in supermarkets can be used too. This should be made up according to the manufacturers instructions. However, unlike agar, this jelly needs to be set for 24 hours in a domestic fridge to be firm enough for the activity. Once firm, the plates were sealed with PARAFILM® or packaging tape.

FIGURE 1. The model microbes in various colors and shapes. A 30-cm ruler is included for scale.

FIGURE 2. A sample petri dish (10-cm diameter) with model microbes embedded in agar that was used for sensory learning when opened, and as a 'piece' of model biofilm when sealed.

4. Close-up images of microbes of various shapes and colors were either drawn or sourced from the Internet and arranged in a presentation in Microsoft PowerPoint (Appendix 1). The different shapes and colors were a way of introducing the children to the concept of microbial diversity. This could be elaborated upon if the activity was being adapted for older students.

The activity

The following activity had three learning objectives: 1) microbes are everywhere, 2) they are small and need to be viewed with special equipment, 3) they work together in groups. To address the first objective, the children were given examples of obvious environments, such as soil, water, their mouths, and their guts, where microbes would live. They were also told that a majority of microbes would not make them ill. To address the second objective, children were shown a basic microscope, and were told that this tool allowed a person to create a 'giant picture' of a tiny microbe. They were then shown pictures on their interactive whiteboard using a Microsoft PowerPoint presentation (Appendix 1), with specific attention to shapes and colors of various microbes. The last picture in the presentation was one of a green biofilm, formed by water flowing along a rock (Appendix 1, image 9). This led them to the third objective, of microbes working in groups or biofilms. They then came up to sample the model biofilms. This contributed to their sensory/tactile learning, where they felt the 'sliminess' of the plate agar (unsealed, open petri dish; Fig. 2). After the children had felt the slimy agar, the nursery teacher discussed microbe shapes with them. Each child then got a 'piece' of a model biofilm (sealed petri dish; Fig. 2), which they used to create their own large biofilm as a group on the floor space (Fig. 3).

CONCLUSIONS

The post-activity feedback from the nursery teachers was very positive. All 31 children were attentive and engaged for the duration (30 minutes) of the activity. Some asked questions throughout. The nursery teachers interpreted this level of activity to mean the children had enjoyed themselves. The teachers also expressed an interest in taking this forward on their own, by further adapting this activity so that the children could construct their own microbes from pasta shapes and create biofilms by embedding the pasta in jelly.

SUPPLEMENTAL MATERIALS

Appendix 1: Sample slide show images and descriptions

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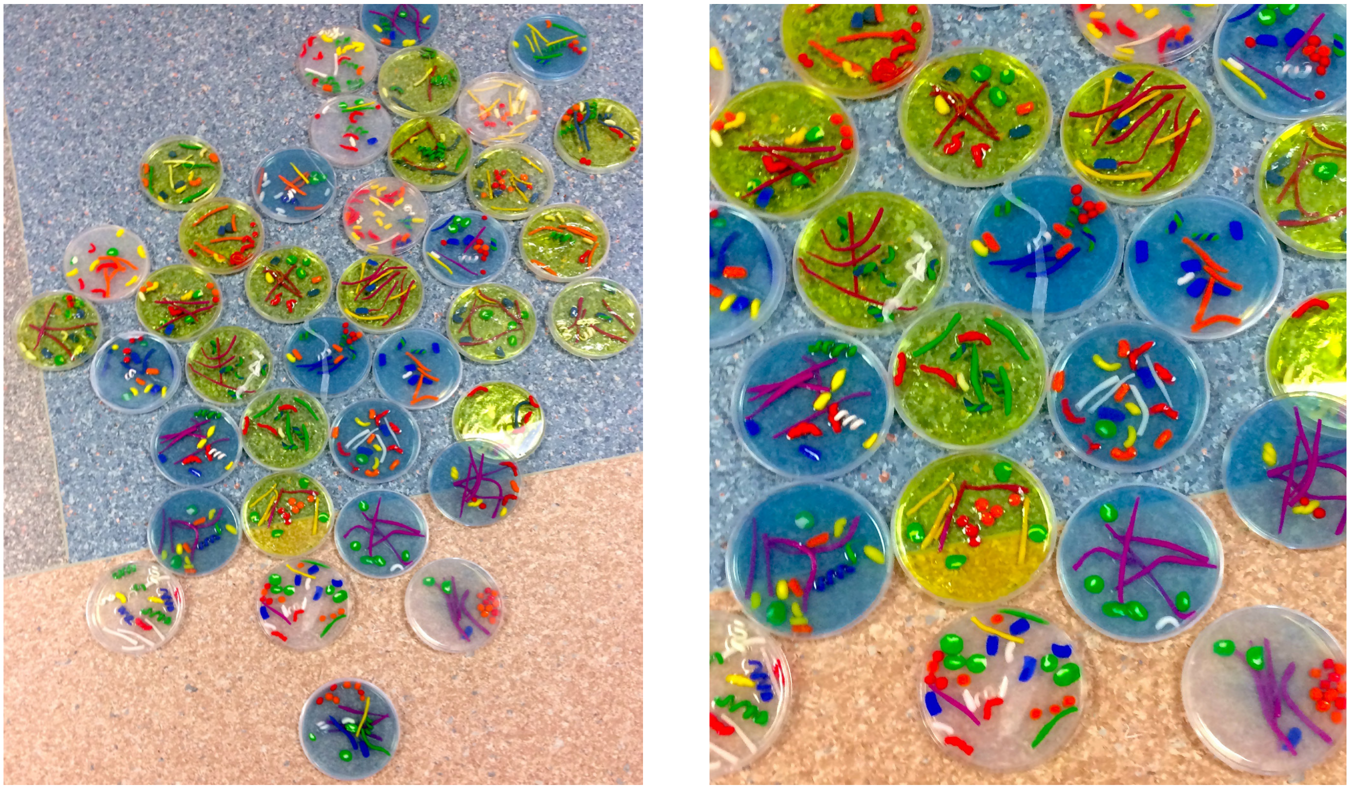

FIGURE 3. Both panels show the model biofilm constructed by the children as part of the activity. Each petri dish was 10 cm in diameter. (A) The whole model was approximately 70 by 90 cm in size. (B) A close-up section of the picture in the first panel, offering a "zoomed" view of the model biofilm.

about science and conduct the activity. Dr. Jillian M. Couto is a Postdoctoral Research Associate, employed on an Engineering and Physical Sciences Research Council (EPSRC) grant for "Synthetic Biology Applications to Water Supply and Remediation" (EP/K038885/1). The author declares that there are no conflicts of interest.

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