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Blast a Biofilm: A Hands-On Activity for School Children and Members of the Public †

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INTRODUCTION

Microbial biofilms are very common in nature and have both detrimental and beneficial effects on everyday life. Practical and hands-on activities have been shown to achieve greater learning and engagement with science by young people (1, 4, 5). We describe an interactive activity, developed to introduce microbes and biofilms to school age children and members of the public. Biofilms are common in nature and, as the favored mode of growth for microbes, biofilms affect many parts of everyday life. This hands-on activity highlights the key concepts of biofilms by allowing participants to first build, then attempt to 'blast,' a biofilm, thus enabling the robust nature of biofilms to become apparent.

We developed the blast-a-biofilm activity as part of our two-day Magnificent Microbes event, which took place at the Dundee Science Centre-Sensation in May 2010 (6). This public engagement event was run by scientists from the Division of Molecular Microbiology at the University of Dundee. The purpose of the event was to use fun and interesting activities to make both children and adults think about how fascinating microbes are. Additionally, we aimed to develop interactive resources that could be used in future events and learning environments, of which the blast-a-biofilm activity is one such resource. Scientists and policy makers in the UK believe engaging the public with research ensures that the work of universities and research institutes is relevant to society and wider social concerns and can also help scientists actively contribute to positive social change (2).

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The activity is aimed at junior school age children (9–11 years) and adults with little or no knowledge of microbiology. The activity is suitable for use at science festivals, science clubs, and also in the classroom, where it can serve as a tool to enrich and enhance the school curriculum.

PROCEDURE

Materials

This activity requires no specialist laboratory equipment. The specifications of the materials listed assume up to three children could take part in the activity simultaneously. Access to washing facilities will be required.

- STAEDTLER FIMO soft modelling clay basic set
- 2 large tubs of standard hair gel (300 ml ideal)
- A large plastic bowl/tray (approximately 35 cm wide, 75 cm long and 10 cm deep)
- 5 plastic containers (approximately 9 cm wide by 9 cm long by 7 cm deep)
- 3 tablespoons
- 3 water sprays or toy pistols
- 1 sieve (for washing model microbes)

Preparation prior to activity

It is essential that demonstrators have a basic knowledge of microbes and biofilms to run the activity, as this will be needed for the introduction given to participants. To enable this, background notes have been provided (Appendix 1).

Small model microbes are created with the modelling clay (e.g., STAEDTLER FIMO) (see Fig. 1). A range of different colored and shaped microbes are made to exemplify the diversity of microbes that live in a biofilm. If this activity is for the classroom, the children could make these models as it will help them to engage in the activity and can be used as a learning point to highlight microbial diversity.

Remove commercial packaging from the hair gel, and re-label the tubs 'matrix.' Label two plastic containers

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with a 'microbes' sticker and label the water sprays/pistols as 'antibiotics.'

Set up the activity on a stand of a suitable height for younger children to ensure they can take part in the activity and with enough room for up to six children to be involved, in which up to three children at any one time can simultaneously build and blast a biofilm.

The stand should be set up as follows; two to three plastic containers are placed upside down in the large tray (equally spaced apart). The water sprays are filled with water. For ease of distribution during the activity place the model microbes in one or two labelled tubs and the matrix hair gel with spoons in front of the large tray (see Fig. 2(A) for suitable set up).

Activity

The activity begins with the demonstrators identifying the children's, and any accompanying adult's, existing knowledge of microbes. Then the demonstrator should introduce the concept of microbes, biofilms, and the theory that it is microbes living in biofilms that can make us poorly. The demonstrators emphasize that microbes in the biofilm produce a sticky matrix that holds the biofilms together protecting the microbes from medicine (antibiotics) and our immune cells. At this point the participants can be asked where on the body one might find microbial biofilms and examples can be given such as dental plaque, illustrating the point that if teeth are not brushed regularly the biofilms can cause tooth decay. However, it is also important to emphasize that biofilms can be useful, e.g., are used in bioremediation processes. The introduction can be aided by reference to a poster (Appendix 2) and if appropriate a ready-made biofilm (see Appendix 3 and Fig. 1(C)). The children are then asked if they would like to build a biofilm and the instructions given are as follows (see Appendix 4):

1. Place microbes onto the solid plastic surfaces.
2. Cover one set of the microbes with the biofilm matrix.
3. Use the water spray to 'blast' the microbes off the solid plastic surface.
4. Discuss with the children the difference the biofilm made to the microbes and the positive and negative implications of biofilm production.

In between each group of children the equipment will need to be washed and set up again. Depending on numbers of children or the setting of the event two sets of equipment could be used (see Fig. 2(B) for picture of game in action). It is also possible to make a model biofilm (see Fig. 1(C) and refer to Appendix 3 for more detail) (3).

CONCLUSION

This activity requires no specialized equipment and provides a very simple and fun way to introduce children and/or members of the public to microbes, clearly eliciting an understanding of the importance of microbes in our everyday lives. The activity is safe and economical to run and can be used in both informal learning environments and the school classroom.

The interactive nature of the activity demonstrates to participants how resistant the microbes in the biofilm are to antibiotics compared to free-living bacteria and, in the case of school children, contributes to their knowledge and understanding of microbes to support related curriculum topics. The activity can be used to effectively communicate health messages such as the importance of regular teeth brushing to bring about practical benefits. Throughout the activity there are ample opportunities for two way interactions.

In addition to providing benefit to the children and adult participants, the activity gives an opportunity for the demonstrators to enhance their skills in science communication and discuss their research.

Thus far this event has been tested by over 2000 children and members of the public at outreach events, open

FIGURE 1. Images showing model microbes created using STAEDTLER FIMO modelling clay. (A) Model microbes placed beside a five pence piece, for size comparison. (B) Microbes in a plastic tub. (C) A ready-made biofilm to show visitors. Here the microbes are captured in 1.5% (w/v) agar in water. For details see Appendix 3.

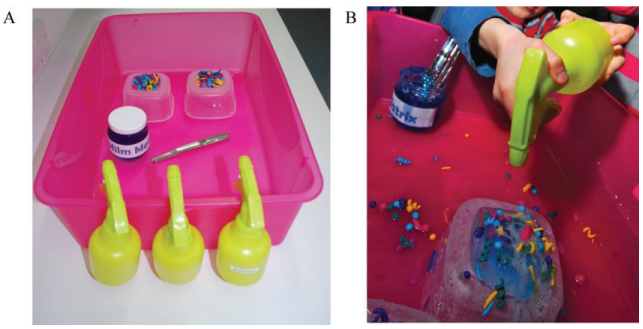

FIGURE 2. Images showing blast-a-biofilm game. (A) Typical set up of blast-a-biofilm game taken prior to start of activity. (B) Picture of the blast-a-biofilm activity in action.

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doors days, and in schools, and feedback has been extremely positive. Children particularly enjoy the hands-on (messy!) aspect of the activity.

SUPPLEMENTAL MATERIALS

Appendix 1: Background information for educators and teachers
Appendix 2: Biofilm poster
Appendix 3: Build a model biofilm
Appendix 4: How to build a biofilm poster

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