

**Dundee Science Centre  
Science Learning Institute**

**Germ Wars 2011**

An innovative project between  
Dundee Science Centre,  
Dundee City Council Educational Development Service  
and Society for Applied Microbiology



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Children and germs are not usually the best combination, but a novel partnership encouraging the link has been celebrated in Dundee.

Around 250 pupils from nine primaries took part in the event today as part of Dundee Science

Centre's science and literacy book project, which aims to promote an understanding of what bacteria are, and their important role in our environment and society.

The kids met Gill Arbuthnott, the author of *Germ Wars*, the book that

inspired the project. As well as getting their books signed and discussing some of the more gruesome chapters, the pupils also had the chance to explore the Dundee Science Centre.

Gill said, "I've always tried to put

plenty of humour in my writing. It certainly has pupils reading who previously didn't and has fostered an interest in science among many who thought it was a bit dull."

Picture shows P6 pupils from Blackness and St Pius primary

schools with (from left) science learning officer Dr Katie Blackett, Moira Foster and Elaine Halliburton of Dundee City Council's education department, author Gill Arbuthnott and science communicator Jillian Jordan.

Article taken from the Evening Telegraph on Friday 17<sup>th</sup> June featuring Gill Arbuthnott and pupils from two of the involved Dundee primary schools during Meet-the-Author event.

## Executive summary

The Germ Wars project aimed to enhance understanding of microbiology, the role of microbes in disease, and furthermore, the existence of beneficial bacteria and their requirement for health and wellbeing. 'Germ Wars' is an educational book written by a local author and science teacher, Gill Arbuthnott, in a very fun and engaging way. The book has proven success with providing a sound educational basis to explore the topic of microbiology, and as such, forms the basis of this three month interdisciplinary project.

*"I just wanted to say thank you for another terrific set of sessions in Dundee. It's obvious that the pupils have found the work you have done with them really inspiring, and I'm honoured to be part of such a great team! I'm already looking forward to next year..."*

**Gill Arbuthnott, author of 'Germ Wars'**

Germ Wars was a collaborative microbiology project developed and delivered by Dundee Science Centre (DSC) in partnership with Dundee City Council Educational Development Service. This project piloted between April and June 2010 enabling 80 local Primary 6 pupils to become engaged with microbiology, and the roles of both beneficial and harmful bacteria in health and disease. This year, the project engaged ten Dundee City Council schools, with 250 Primary 6 pupils taking part.

*"I enjoyed the book because it was really educational but funny at the same time."*

**Pupil**

Schools took part in this project over a three-month period from April to June, with a range of activities throughout this time. Teachers attended a Continuing Professional Development (CPD) session and were provided with resources to support them through the project. In early June staff from Dundee Science Centre visited each school and delivered a workshop called 'Befriending Bacteria'. Finally, each school visited the centre to meet Gill Arbuthnott, author of the book 'Germ Wars', to conclude the project and have their books signed as a memento of their learning experience.

Evaluation of this project indicates that teachers' confidence increased along with their enthusiasm for teaching microbiology in future years. Additionally, pupils expressed a high level of enjoyment and a wish to learn more about the subject. Teachers also commented that this project has nice cross-curricular elements and is in-keeping with the ethos of Curriculum for Excellence.

*"I learned MILLIONS that my brain is actually tired, it's that full!"*

**Pupil**

Overall, this project proved to be a great success, with both teachers and pupils having a memorable learning experience. Teachers had the opportunity to learn in-depth knowledge about the subject, backed up by resources and the support of DSC staff with a sound background in microbiology. This extra support was invaluable to teachers, and led to an increase in their own knowledge, but also confidence to teach the topic. This highlights a key aim of this project, which was to not only engage the 250 pupils with microbiology, but also to enthuse teachers about the subject, laying the foundation for their continuous development and repeated microbiology-based projects through future years.

*"This was a great project, I learned all about small pox, bacteria and wallaby milk! I would definitely do it again!"*

**Pupil**

## Introduction

Germ Wars is a collaborative microbiology project developed and delivered by Dundee Science Centre (DSC) in partnership with Dundee City Council Educational Development Service. This science and literacy project, which was piloted between April and June 2010, enabled 80 local Primary 6 pupils to become engaged with microbiology, and the roles of both beneficial and harmful bacteria in health and disease. This year, 250 pupils from 10 schools in Dundee City took part in this project.

*"I learned about bacteria I never even knew about!"*

Pupil

The Germ Wars venture was based on an already established project, Crazy Creatures, which explores the topic of biodiversity, utilising the 'Crazy Creatures' book by Edinburgh based author, Gill Arbuthnott. Crazy Creatures has been running with Dundee schools for three years, providing pupils with their own copy of the book and a hands-on science workshop, followed by a visit to the centre to meet the author. This project is extremely popular, receiving high acclaim from Her Majesty's Inspectorate for Education, being the subject of one of their case studies. While researching other works by Gill Arbuthnott, 'Germ Wars' was discovered, which makes the subject of microbes fun and engaging. The book describes a range of nasty diseases, the history of vaccines and antibiotics, and what the future holds for our relationship with microorganisms. These multidisciplinary projects support Curriculum for Excellence, providing a cross-curricular activity, linking science and literacy.

Curriculum for Excellence is the Scottish framework which aims to provide a coherent and flexible curriculum to support learners develop key skills and attitudes. It aims to develop four main capacities in these learners to help support life-long learning: confident individuals, successful learners, effective contributors and responsible citizens. To achieve these targets, each subject has a range of 'Experiences and Outcomes', a set of statements, which through active learning experiences provide a depth of learning leading to completion of that outcome. Furthermore, through wholly completing these experiences and outcomes, each individual builds towards these four main capacities.

Health and wellbeing is an important part of the Curriculum for Excellence, with disease and the role of microorganisms being a topic from age 6 through to age 14.

The learning outcome for microbiology subjects state that:

"Through observation, research and practical investigation learners explore the risk and impact of microorganisms in relation to health."

To achieve this, the experience and outcome for this age group (Primary 6) is:

"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."

For primary teachers, this subject can be very difficult to provide practical learning experiences for. Therefore, this project aimed to support teachers deliver an active learning experience for their pupils, in a subject which is often avoided or not thoroughly explored due to the clear barriers in observing

microbiology in action! Germ Wars was a science and literacy project which used a range of cross-curricular techniques to teach microbiology in an exciting and engaging format.

This project began with a CPD training session for teachers, introducing them to the workshop and the overall three month project. In April, Moira Foster, an expert children's librarian from the Dundee City Council Educational Development Service delivered the 'Germ Wars' books to the excited pupils, providing each child with their own copy to keep for life. Throughout the following six weeks the schools were given freedom to explore the book and its related topic at their own pace, and as in-depth as they wished. At the CPD teachers were provided with a range of resources, including activities for the classroom and a list of online resources to help them explore the topic during this time.

*"They loved the book! There was always a little chorus of "Yes!" when I said we would read it. Very accessible. Some bits were difficult, e.g. body's defenses, but children always engaged."*

**Teacher**

In June, staff from DSC visited each school to deliver the workshop 'Befriending Bacteria' - it was important to give the pupils an all-encompassing view of microbiology. At the end of term, pupils visited DSC to meet Gill Arbutnott, where she discussed her book and stressed microbes' importance on Earth and for our survival. The pupils were enthralled and excited to meet the actual author of the book they had been so involved with for ten weeks.

*"I learned that you do get good germs!"*

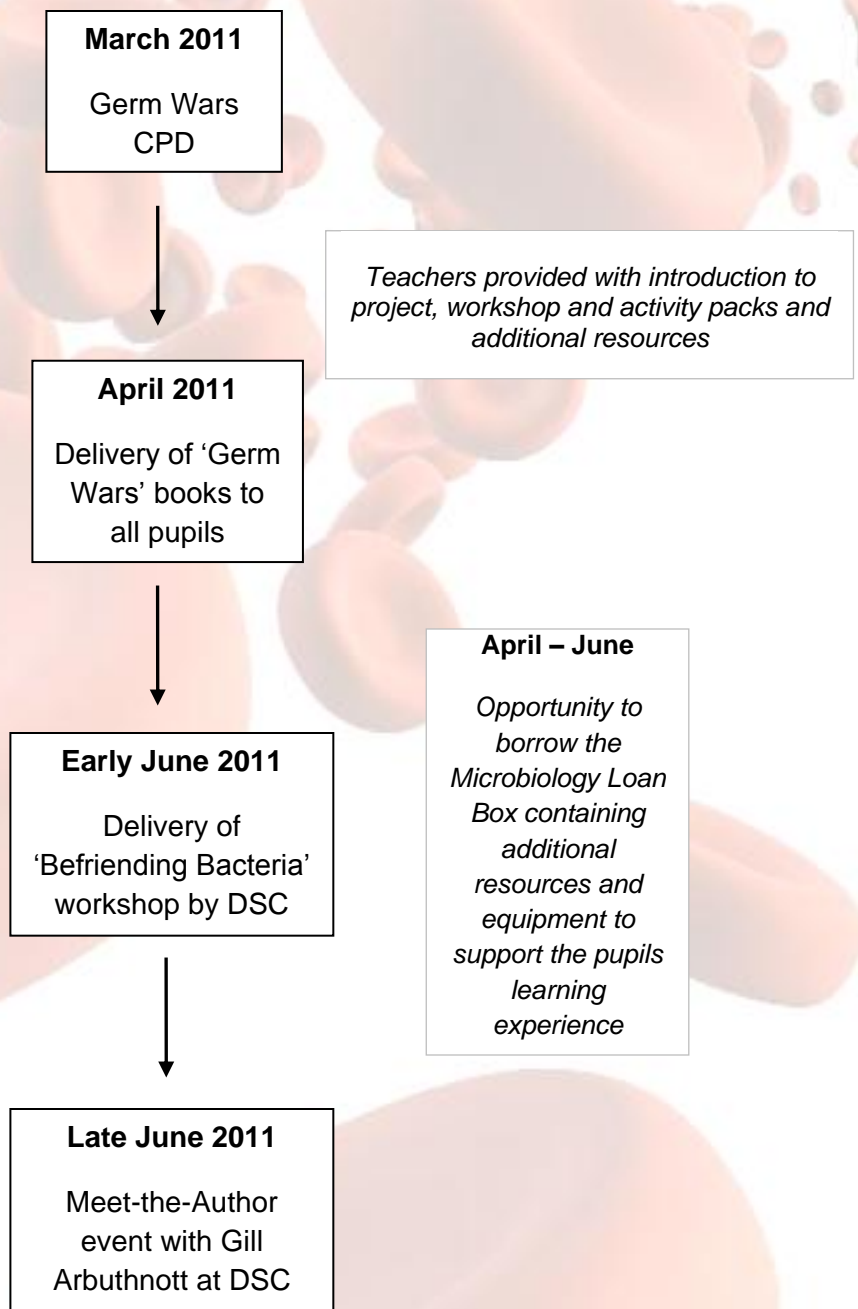
**Pupil**

One of DSC's main objectives is to create an environment for lifelong learning, hoping to inspire confident learners who will go on from the experience enthusiastic to find out more. To help contribute to this mission, DSC provides loan boxes for the classroom. These are a free resource full of equipment and activity ideas to help teachers follow on from what the pupils have learned during a workshop. Through SfAM funding of Germ Wars 2010, a Microbiology loan box was developed to complement this project, and be used as an individual resource out with this project framework.

Each class involved in Germ Wars 2011 had the opportunity to borrow this Microbiology loan box, with eight out of ten schools doing so. This resource box is full of extra equipment and ideas to help pupils learn about microbiology through practical activities and investigations, including UV lights and UV fluid, a microscope, and an activity book including plans for 'Yeast Balloon' investigations.

Through pre and post evaluation of this project it is clear that Germ Wars impacted greatly on not only pupils' interest in, and understanding of, microbiology, but – moreover - teachers' knowledge increased, along with their confidence and motivation for teaching the subject in future years.

## Project timeline



## **Impact on practice**

A learning experience should be evaluated according to its impact on learners, especially in impact on understanding, attitudes and practice.

## **Methodology**

The CPD course was evaluated through hard copy feedback forms completed by delegates immediately after the course, to assess initial reactions and experience of the course itself, along with their initial thoughts and feelings about the project. These forms consisted of Likert scale questions to assess impressions of enjoyability, usefulness, inspiration and motivation, and open text questions covering the most useful aspects of the course, areas for improvement, impact on professional practice and any intention to use the course content. Additionally, Likert scale questions assessed how they felt about the project specifically (excitement, confidence, inspiration and motivation) and their confidence in teaching microbiology.

On-the-day feedback questionnaires were completed by the vast majority of delegates.

Evaluation forms were then sent to all teachers after the project to gauge actual impact experienced by the teachers and the pupils. Likert scales assessed impressions of excitement, confidence, inspiration and motivation/engagement by teachers and pupils. Furthermore, open text questions covered the pupils' engagement with each input of the project, key skills gained by the pupils, teachers' confidence to teach microbiology in future, and room for improvement. Pupils were asked the most and least favourite parts of the project, what they learned, and how they felt about each input; the 'Germ Wars' book, Microbiology Loan Box, 'Befriending Bacteria' outreach workshop and meeting the author.

Three of the ten participating schools responded to the post-project survey.

A selection of delegates also provided further comments to give a deeper insight into their experience. A number of Head Teachers and participating teachers also contacted the Science Learning Team or Dundee City Council to make comments on the pupils and teachers enjoyment of the project and its impact.

## Empowering educators

All teachers, including head teachers from each school were invited to attend a CPD course in March 2011, to introduce the project and provide teachers with resources and activities to support them. Participants were told more about the book, and experienced the 'Befriending Bacteria' workshop which would be delivered to schools on outreach later in the project. Finally, teachers were provided with a list of websites and resources, and through the kind contribution of e-bug initiative, were each given a hard copy of the e-bug teacher pack. Additionally, a Dundee Science Centre activity pack was developed, providing teachers with some ideas for investigations, with lesson plans and worksheets to guide them.

Likert scales assessed impressions of enjoyability, usefulness, inspiration and motivation. Enjoyability and usefulness scored highest with the majority of teachers scoring 8 out of 8, giving an average score for each of 7.6. Teachers did find the course motivating, commenting that they were excited to *"get started on the project"*, felt *"much more confident and enthusiastic"* and *"may not be as wary about tackling science as a topic"*. Motivation scored an average of 7.5 out of 8 from the teachers, while they found it slightly less inspirational, giving 'inspiration' an average score of 7.25.

Teachers were also asked to score how they felt about the Germ Wars project specifically. Interestingly, scores were highest for how motivated they felt about it following the CPD, with an average score of 7.8 out of 8, with only one respondent not scoring at the top level. Inspiration and excitement scored highly, at 7.5 out of 8, with comments including, *"I'm looking forward to the class's reactions to the project"* and *"it's an exciting project for the class to participate in!"*

Feedback scores from teachers indicated that they did not feel confident about teaching microbiology (5.6 out of 8), with one teacher scoring themselves at only 1 out of 8.

Comments from teachers suggest that half felt moderately confident, or OK to quite confident about teaching microbiology after the CPD and acquiring the available resources, while one teacher said *"I'm not confident at all – science is an area that doesn't interest or motivate me."* As responses were anonymous it was not possible to compare with before and after to find out whether this teacher felt more confident after the project.

Given the low base level of confidence, post-project feedback was very encouraging, revealing that overall scores for confidence had increased to 6.7 out of 8 (from 5.6).

Delegates were also asked to comment on the most useful parts of the session, and any key messages they had gained from the CPD. The majority of teachers said they found the new knowledge gained and resources provided the most useful element. Other comments included *"Explaining difference between 'good' and 'bad' bacteria, and the links to healthy eating"* and *"Microbiology is fun/kids will love it!"*

Finally, delegates were asked how the course would affect professional practice. Fifty percent of the teachers stated that the course had boosted their confidence, and they felt much more confident and enthusiastic about starting the project. While one teacher stated that it *"will extend science activities and development of science curriculum in teaching"*.

Overall, teachers seemed to leave the CPD feeling inspired and enthusiastic about the project, and appreciated the extra resources and information provided.

## Impact of the project

In the following weeks after the project was complete, teachers were asked to comment on the project and provide feedback on different aspects. As previously, Likert scales assessed levels of excitement, confidence, inspiration and motivation experienced by the teachers. In addition, teachers were asked to score their impressions of the pupils' excitement, confidence, inspiration and engagement.

Only three of the ten schools responded to the post project survey, therefore an accurate representation of all teacher and pupil experiences is not available. Those that did respond, however, provided detailed feedback.

In terms of teachers' feelings about the project, highest scores were gained for their motivation (7.3 out of 8), while there was a slight reduction in overall scores for their excitement and inspiration (7 out of 8 compared with 7.5 previously). Although teachers seemed to score slightly less for these, scores were higher for their confidence, with an average score of 6.7 out of 8, an improvement from 5.6 at the start of the project. When asked how they felt about teaching microbiology in the future, two commented that they would feel more confident to do this, while the third said *"Great project, definitely do again!"*

Scores were also obtained for how teachers thought the pupils felt about the project. These impressions scored highly, with pupils' excitement, confidence and motivation each scoring 7.3 out of 8, while assessments of inspiration provided the highest score of 7.7 out of 8. These results correspond well to how the pupils scored their own enjoyment of the project, with an overall score from all pupils in the three responding schools of 7.3 out of 8.

Teachers were also asked to score levels of engagement for both the 'Befriending Bacteria' outreach delivered by Dundee Science Centre, and the Meet-the-Author event. These project components scored highly, with the outreach achieving top scores (8 out of 8), while the Meet-the-Author scored 7.7 out of 8. Finally, Likert scales were used to assess whether the pupils would like to learn more about microbiology, this scored slightly less, however, there was an average score of 6 out of 8, with only 22% of pupils providing a score of less than 5 for this element.

These Likert scale results indicate a high level of engagement, enjoyment and enthusiasm for the project, from both the pupils and teachers. Most encouraging are the high scores for pupil engagement and level of inspiration created by the project, with many pupils wanting to continue their learning of microbiology. For future implications of the project, the increased score for confidence, with teachers specifically noting that they felt an improvement in their understanding of the subject (post-CPD) and a wish to teach it in future, highlights the core value of such collaborative, immersive and supported projects.

## Teachers' impressions

To gain an increased understanding of specific engagement with the project, pupils and teachers were also asked a range of open questions.

Firstly, teachers were asked to comment on the pupils' engagement with the 'Germ Wars' book, specifically their enjoyment, understanding and the book's suitability to the project. Two of the three teachers commented that the book was very accessible and the children loved it and were excited about the content, while one noted that they found the content to have excellent factual information.

*"The book had excellent factual info, backed with gruesome but interesting detail."*

Teacher

When asked about engagement with the outreach workshop, 'Befriending Bacteria', all teachers scored 8 out of 8. Further comments were requested, and feedback was encouraging. Two of the three teachers said *"pupils thoroughly enjoyed and engaged"*, with further remarks on the staff from Dundee Science Centre interacting well with the children, bringing good visual props, and providing a workshop which had a good balance of listening and activities.

The three responding teachers scored the engagement with the Meet-the-Author event, indicating a level of engagement of 7.7 out of 8. Comments were again extremely encouraging, with two of the teachers saying the children felt very important meeting the author and getting their books signed, additionally, pupils were very engaged, felt comfortable asking lots of questions, and the event extended the pupils knowledge and understanding.

Responses from these evaluations are extremely positive, suggesting that the format of the three-month project is successful, with each component (teacher CPD, outreach and Meet-the-Author) providing a supportive and enjoyable basis for extended learning.

An additional support for the project was Dundee Science Centre's Microbiology Loan box, which was developed as part of Germ Wars 2010.

Eight of the ten involved schools borrowed this additional resource. The three schools which responded to the evaluation form had utilised the resource, with all three saying they found the UV light box and fluid a helpful activity. Additionally, one teacher commented that the *"children were very excited about the microscope and used it a lot"*.



Dundee Science Centre is dedicated to helping teachers deliver *Curriculum for Excellence*, and this was a key aim of this project. Teachers were asked to comment on what key ideas, skills and attitudes pupils gained from the project. Although only three schools responded to the questionnaire, extensive

answers were provided for this question, indicating that teachers felt strongly about how well the project contributed to the curriculum.

All three respondents said that the project contributed very well to CfE, with active learning and cross-curricular links. At least two of the three teachers also commented that the children fully engaged with all activities, learned new skills and "...developed informed attitudes in an exciting and fun-filled way". Further comments included "Science is fun!", children learned "...how easily germs spread" and that "...there are good and bad bacteria".

Responses to the project's contribution to CfE:

*"Very much so! Most definitely active learning. Lots of cross-curricular links. Children were fully engaged in activities and learning skills and developing informed attitudes in an exciting and fun filled way."*

*"Active, appropriate and new area for pupils!"*

**Teachers**

When asked for an overview of the whole project, all three teachers said there was no area which the pupils did not engage with or enjoy. One commented that the ebug book and website, along with the CPD were invaluable to them, while another said the "children loved being 'scientists'", and taking part in active learning.

*"Children learned how easily germs can spread, that there are good and bad bacteria, and Science is Fun!"*

**Teacher**

Final comments from the three were, "Thanks to all involved", "Staff were excellent and a pleasure to work with" and "A project enjoyed by teacher and pupils!"

## Inspiring learners

Pupils were given a short evaluation form to find out how they felt about the project, this feedback was extremely valuable in including the teachers perspectives.

As mentioned previously, when using Likert scales pupils scored 7.3 out of 8 for overall enjoyment, and 6 out of 8 for wanting to learn more about microbiology.

When asked what their favourite part of the whole project was, the majority highlighted meeting Gill Arbuthnott (56%). Twenty five percent mentioned their enjoyment of using the UV light and Glo gel to "contaminate each other" and "learn how far a sneeze can go!". Also highlighted by pupils, to a lesser degree, were reading the book, learning about microbes and diseases and doing experiments (10%).

Pupils were also asked to comment on their least favourite aspect, with the majority saying nothing, they enjoyed it all (55%). However, a small number mentioned that they did not like "all the gruesome stuff" (14%), and the book was too short (5%).

*"I am really proud of how the project has gone this year. The comments from the teachers and the obvious knowledge and enthusiasm of the children are real indicators of its success. I was speaking with the Depute Head of Glebelands Primary School and she told me that after the outreach visit from DSC she thought one of her pupils had been captured and replaced by a new boy! She said he was completely engaged and had enjoyed the session so much it had positively impacted on his behaviour which was normally not that great."*

**Moira Foster, Dundee City Council Educational Development Service**

When asked what they liked about the book 'Germ Wars' 23% commented that they learned many new facts about microbiology, a subject which they did not know or understand anything about

previously. While many pupils said they liked the style of writing and funny illustrations and stories (29%). Additionally, some children explained which fact/story they learned about and enjoyed most, including Edward Jenner and small pox, penicillin and wallaby milk, and of course Black Death!

Open questions also assessed how well the children engaged with the loan box and which parts they enjoyed most. Half of the children, when asked what the least favourite thing was, commented that they liked everything, while one pupil said their least favourite thing was *“realising how many germs are probably on my hands!”* Pupils remarked that the UV gel (58%) and microscope (36%) were the most enjoyable resources in the loan box.

The ‘Befriending Bacteria’ workshop included some presentation from staff at Dundee Science Centre, interspersed with activities, including making a dental plaque and designing a microbe. Responses from pupils, not surprisingly, indicated that the most enjoyed aspect was the cross-curricular activity of designing their own microbe (79%). Others also mentioned learning more about germs, making the dental plaque, the pictures of different microbes and diseases, and being asked lots of questions.

*“I learned that there are thousands of bugs in your guts!”*

Pupil

The final aspect of the project was meeting the author, which provided an opportunity for the pupils to meet with Gill Arbuthnott, ask her questions and have their books signed. Many of the pupils liked having their books signed, which they commented could be kept as a memory for the project. Other comments including enjoying seeing lots of gory pictures, finding out more facts, good explanations from Gill, and getting to ask her lots of questions. Three of the pupils mentioned hearing Gill’s story about the Black Death and Eyam village, which was used as a format for explaining quarantine and its origins.

*“Pupils couldn’t believe they had met a ‘real-live author!’”*

Teacher

Finally, children were asked what they had learned, providing a range of different answers, the most common answer was that some bacteria are bad and some are good (27%), while other topics mentioned were vaccination, the immune system, deadly diseases, different types of microbes and the importance of hand washing.

Further specific comments provided by the pupils are provided throughout this report as testimonials.

## Further impacts

The project also had some major impacts and extensions that were unexpected. At one school, a group of girls had introduced Germ Wars to their whole Brownie pack. When Dundee Science Centre staff went out to the school they presented a large poster researched and designed by the pack about Millennium Development Goal 6, detailing all the information they had found out about malaria and the government initiative.





## **Acknowledgements**

We have been delighted to work with Gill Arbuthnott, the author of 'Germ Wars', Moira Foster and Elaine Hallyburton from Dundee City Council, and - of course - the ten Primary 6 classes in Dundee. Our thanks go to Society for Applied Microbiology for their continued support of this great project.

Special thanks to:

Glebelands Primary School  
Forthill Primary School  
Blackness Primary School  
St Pius Primary School  
Park Place Primary School  
Craigowl Primary School  
Ancrum Road Primary School  
St Joseph's Primary School  
St Ninian's Primary School