

**DISCOVERY
AWARD**



DROPLET DETECTIVES

Cracking the code to a healthier school

Teacher pack



TEAM PROJECT

Working in teams, students are challenged to find solutions to reduce the spread of common airborne infections in their school.

#Infection

#Research

#Data

#Investigate

#Communicate

#Attendance



Managed by



In partnership with



NHS
University College London Hospitals
NHS Foundation Trust



National Institute for
Health and Care Research

Content



Background 3

University College London's Air Safety Programme

Project overview 4

CREST Award levels

The Droplet Detectives challenge

Learning objectives

Discovery Award in a day 5

Step-by-step-guide 6

Pre-project preparation

UCL's research project

CREST Award project Droplet Detectives

Activity one: Be a data detective

Activity two: Investigate filter materials

Activity three: Spread the word

Presentations

Appendix A CREST Discovery Award 11

Teacher's guidance

CREST Discovery Passport workshops

Appendix B Curriculum links 12

England

Northern Ireland

Scotland

Wales

Appendix C Acknowledgements 14

Background



Project background

Many universities in the UK conduct research projects to advance scientific knowledge and help develop solutions to complex public health problems.

This CREST Award project has arisen from a partnership between the British Science Association, University College London (UCL) and University College London Hospital (UCLH).

The partnership enables young people to learn about careers in research and the role of science, technology and engineering to develop solutions to real-life problems.

Through following the work of the [Air Safety Programme](#) research team who are investigating ways to reduce the spread of airborne infections in hospitals, students will gain valuable insight into the role of health research to improve scientific knowledge and to reduce infection rates in healthcare settings.

Whilst the context for UCL's programme is hospital based, this CREST Award challenge enables students to use their knowledge and skills to apply their research to their own school setting.

University College London

University College London (UCL) is one of the world's top universities, with broad disciplinary excellence in research, innovation, education and impact.



University College London Hospitals

UCLH (University College London Hospitals NHS Foundation Trust), situated in the heart of London, is one of the largest NHS trusts in the United Kingdom and provides first-class acute and specialist services.



University College London Hospitals
NHS Foundation Trust

The work of the research team is also funded and supported by:



Project overview



CREST Award Levels

Droplet Detectives has been developed to support students meet the criteria for the CREST Discovery Award.

Through undertaking the following activities and completing a CREST Discovery Passport, your students are eligible for a CREST Discovery Award.

The materials have been designed to use flexibly and can be used to support the delivery of parts of a formal STEM curriculum or as an extracurricular activity.

The project takes approximately 5 hours to deliver and needs no prior knowledge of science research on infection control.

The challenge

During this project, students work in teams of 3-4 to:

- Plan and conduct research into whether common airborne infections affect children and young people's school attendance
- Analyse data to help identify and develop ideas to reduce the spread of airborne infections in their school
- Learn about possible hotspots for the spread of infection in schools
- Conduct a scientific investigation to test materials for their effectiveness as filters
- Develop a public health sticker, poster or method of communication to help people use air filters to reduce the

spread of airborne infection

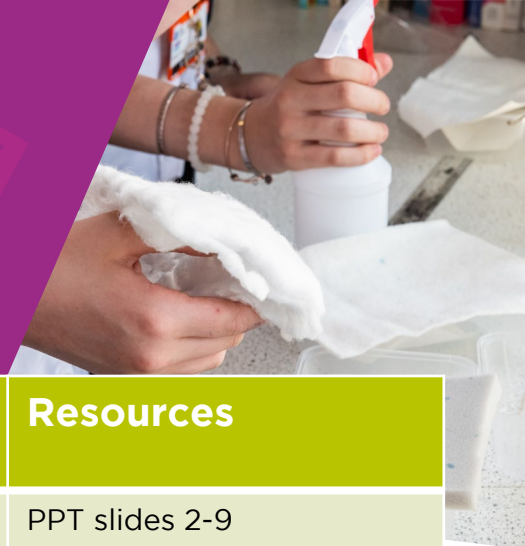
- Present their ideas on how to improve school attendance by reducing the spread of common airborne infections.

Learning objectives

Students will:

- Learn how universities carry out scientific research to address real life problems
- Learn about different job roles involved in science research projects
- Learn how airborne infections spread and lead to illnesses
- Learn about different ways in which individuals and organisations can help to reduce the spread of airborne infections
- Plan and conduct research in their class/school
- Explore data to help inform ideas on how to reduce the spread of infection in school
- Understand the role of health education and communication to help people reduce the spread of infection.

Discovery Award in a day



Activity	Timing (5hrs)	Resources
<u>Introduction</u> Health research at UCL – the Air Safety Programme Video clip and comic strip introducing the problem of infection control What is airborne infection?	15-20 mins	PPT slides 2-9
<u>Droplet Detectives CREST Discovery Award</u> Setting up teams Setting out the project tasks Discovery Award Passports	15 mins	PPT slide 10 1 x Discovery Award Passport per student
<u>Be a data detective</u> Students plan and conduct research on absence rates in class/across the school Students analyse data and present results	30 mins-1hr	PPT slides 11-14 School absence data (if available), or sample UK absence data Paper/pens Student activity sheets IT access for questions/presenting results (optional)
<u>Science research at UCL</u> Introduce the research team, robot Sonny, AI tools and app to simulate the spread of airborne infection to identify hotspots How do filters work to filter out particles? Investigation: testing filter materials Planning and conducting research to test materials for filtering properties	1h 30 mins	PPT slides 15-26 Student activity sheets 10 x fine mist water sprayers 10 x margarine tubs or petri dishes Filter or grid paper Water with food colouring. Filter materials for testing (J-cloths, kitchen roll, felt, cotton fabric, face masks, hessian)
<u>Spread the word</u> Introduce the problem that air filters are sometimes not used properly Students develop a suitable health message to encourage people to use them correctly and help reduce the spread of infection	45 mins	PPT slides 27-29 Student activity sheet Paper Coloured pens Access to computer for design work (optional)
<u>Presentations and reflection</u> Students plan and present their research findings and ideas on ways to reduce the spread of airborne infections and improve attendance, then reflect on their project using a CREST Discovery Passport	1hr 15 mins	PPT slides 30-33 Student activity sheet Access to PPT/paper for presentations Discovery Passports

Step-by-step guide



Pre-project preparation

Register with CREST

Register your students for their Awards by signing up for a CREST Account [here](#).

For Discovery Award level, you need to enter the project name *Droplet Detectives* with the names of your students. You can pre-order certificates to present at the end of the project.

Familiarise yourself with the Discovery Award assessment criteria on page 11 (Appendix A).

Discovery Award students are required to complete a [Discovery Passport](#).

Curriculum links

Whether you are running the project in a day, as part of a STEM club or curriculum time, *Droplet Detectives* will help to deliver parts of the formal curriculum. Links to the curriculum for England, Wales, Scotland and Northern Ireland can be found on pages 12-13 (Appendix B)

STEM Ambassadors

Consider inviting a STEM Ambassador to introduce the project, support the day and/or give feedback on the students' presentations. Find a STEM Ambassador [here](#).

Project resources

Download the *Droplet Detectives* supporting slides, student pack and Discovery Passports. Make copies as needed.

Within the student pack there are differentiated worksheets for two of the activities. Select the ones that best suit your students.

Prepare any resources to support the three workshops: *Be a data detective* (explore health and absence data), *Investigate* (testing filter materials) and *Spread the word* (health education messaging). See resource requirements on page 5.

Team and project management

Decide how to organise your students into teams. You might want them to self-select or decide on the make-up of the teams.

Then consider how best to manage the project in a way that works for you and the students. Ideally, we recommend that all students are given the opportunity to participate in the three main activities – *Be a data detective*, *Investigate* and *Spread the word*. This enables them to engage with the work of the different research teams working on UCL's Air Safety Programme.

Alternately, the activities can be divided between the team members and brought together when the students present their work.

For the *Be a data detective* activity, you will need to check in advance whether your students can gain access to whole school and/or class data on levels of absenteeism and/or whether it's feasible for them to conduct whole school or class research. Be aware of data protection and your school policies here and ensure that any absence figures provided are anonymised and do not include any sensitive data.

If this proves too challenging, school data on national and regional absenteeism rates can be found [here](#). There is also some model data in the student pack that can be used as well.

Hopefully, you now feel ready to start the project!

UCL's research project

Using PPT slides 2-3, introduce your students to the role of universities to run a range of courses and to conduct research. The map of universities in the UK only shows the larger universities. A full list can be viewed by region of the UK [here](#).

Introduce UCL as a university that conducts science research. You might choose to show the most recent example of their science research by visiting [UCL's website](#).

Now set the scene and context for the project by showing the video clip and comic strip on PPT slides 4 and 5, introducing the problem of infection spread within UCL's hospital.

Consider COVID-19, infection control measures in hospitals and airborne infection using PPT slides 6-9.

CREST Award: Droplet Detectives

Introduce the students' own research project brief. PPT slide 10 gives an overview of their project tasks.

This is also a good time to hand out their Discovery Passports and explain how they need to be completed to gain a CREST Award.

Be a data detective



Activity One: Be a data detective

Set the scene for *Be a data detective* by explaining that their project is about ways to reduce the spread of airborne infection to improve attendance in school.

Use PPT slide 12 to introduce how schools collect data on absenteeism. Use the questions to prompt discussion about how schools collect and share absence data with UK Governments.

You could introduce terms such as authorised and unauthorised reasons for absence.

For your own information and/or to provide recent absence data from UK schools by region go to:

[England](#)

[Northern Ireland](#)

[Wales](#)

[Scotland](#)

Absence data from your own school

If possible, ask for absence data from your school that you feel is most relevant and accessible to your students. Be mindful of data protection and school policies, ensuring that any details shared are anonymous and do not include sensitive information. If available, the data could include:

- Absence data for a class or year group per month across a school year.
- Main authorised reasons for students' absence (by illness categories) per month.

Depending on time available, you might choose to present this data to your students. Otherwise encourage them to conduct their own research into absenteeism.

Use the questions on PPT slide 13 to prompt discussion about what information they want to find out. Allow the students time to plan and carry out their research.

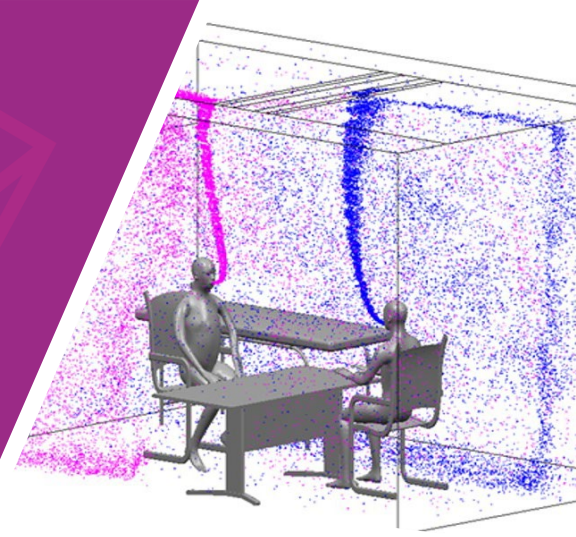
Once they have carried out their research ask them to record and present (through graphs, tables, charts, etc) their data to share in their presentations. There are templates available in the student pack to support this activity.

Ensure that the students have the chance to reflect and share key findings. This might include:

- Patterns of absenteeism throughout the year.
- Different reasons for absence throughout the year, including any patterns for airborne infection rates.

If it is not feasible for your students to consider their own school data, use the national data available. They could also consider the model data in the student pack.

Science research at UCL



Airborne infections

You will have already introduced the students to general science knowledge about how aerosol droplets spread infection. But now we move to UCL's innovative research on transmission of airborne infections.

Before introducing UCL's research you might like to demonstrate how aerosol particles move through the air. You could use a spray deodorant at the front of the class and allow the students to time how quickly they can smell the deodorant in different parts of the classroom.

Now introduce UCL's Air Safety Programme, with PPT slides 15-18 and the video clips about the research team and the development of Sonny the robot, plus laser technology to simulate and capture the dispersal of aerosol droplets.

Prompt question: Why would the research team develop a robot instead of using a real person?

Use PPT slides 19-20 to show UCL's research journey with the development and use of an app and Artificial Intelligence (AI) to simulate the dispersal of airborne infections in hospital settings.

Analysis of data has provided increased understanding of infection hotspots area within hospitals.

Where are the infection hotspots likely to be in a school?

You might ask some or all the children to sketch a plan of the school or make a list of rooms and spaces.

Then encourage them to record the journeys they make to different spaces in the school throughout the day. Invite them to consider which spaces other classes and/or year groups visit throughout the day. This should help children to identify potential infection hotspots with the school.

This information can be used to help them make decisions about where in the school infection control strategies such as opening windows and/or using air filters are most needed.

Testing filter materials



As UCL's researchers learnt more about infection hotspots they invited a team of engineers to identify and test possible solutions to reduce airborne infection. PPT slide 21 highlights some of the ideas they tested, including air filters.

Use PPT slide 22 to introduce filtration as a method of filtering solids from liquids and/or gas and to show how a basic air filter works.

This [video clip](#) explains how air filters work in more detail.

Explain why the different layers are important to filter different size particles.

Ask students for examples of the use of liquid and air filters at home. They include:

- Liquid filters – coffee filter and tea bag.
- Air filters - face mask, inside of a vacuum cleaner and tumble dryer.

Activity Two: Investigate - testing filter materials

Use PPT slide 24 to introduce the science investigation to test the filtering properties of different materials.

Suggested equipment per small group:

1 x margarine/plastic tub or petri dish

1 x fine spray water bottle containing a mix of water and food colouring (NB. Make sure the liquid is a strong enough colour to show on the material when sprayed).

A range of materials to test, e.g. J-cloth, paper towel, face masks, cotton fabric, hessian, mesh from fruit bags, cotton wool pads. (NB: ensure some of the materials have an open weave to allow aerosols to pass through).

6 x filter papers and/or pieces of grid paper (to enable observation of aerosol dispersal through the filter material).

Explain to the students that the coloured water represents aerosol particles that a person infected with a cold could release.

Discuss the following:

- How they might set up an experiment to test a range of materials to find the best filter.
- Fair testing and control measures, e.g. spray dispersal from the bottle, distance between the spray bottle and filter materials
- How to measure the amount of aerosol droplets captured (filtered out) and the amount transmitted through the material.

Differentiated investigation planning and recording sheets are included in the student pack for this activity.

For students with SEND or those who need more support with planning the investigation, use PPT slides 25 & 26.

Extension ideas:

- To extend the investigation, ask students to consider more variables such as multi-layering the materials and/or pleating or folding the materials to test for increased efficiency.
- If your school has microscopes, encourage the students to observe the structure of the filter materials. They might see a link between the structure of the materials and aerosol transmission.
- If your school has scales and balances, students could measure transmission through mass gain. This would enable greater accuracy and repeatability.

Health and safety

During science investigations, students need to work safely. Encourage the students to identify the risks involved in each practical activity or investigation. Demonstrate safe use of tools and equipment. Students using equipment should be closely supervised.

For this investigation students could wear safety goggles if you feel appropriate. Note that water coloured with food dye can stain hands and clothes.

Contact [CLEAPSS](#) directly for any specific health and safety advice. Teachers in Scotland should refer to [SSERC](#).

Spread the word



Activity Three: Spread the word

Set the scene for this activity with PPT slides 28 & 29.

Explain that whilst investigating the use of air filters in hospitals, UCL's engineers were surprised to find that the air filters were often unplugged or switched off.

When clinical staff were asked to give reasons for this, they cited their lack of awareness of the value of air filters and their busy work schedules in a hospital environment.

Prompt questions:

- Do you think the same might happen in a school too?
- What do you think is the best way to make sure people don't switch off crucial air filters?

In this activity the students are asked to imagine that their school has started to use air filters to help reduce the spread of airborne infections.

They need to develop an idea for a way to encourage people to use the air filters properly, keeping them plugged in and switched on!

Students could design a poster, leaflet or plug sticker to highlight and share key messaging.

and why – what impact would they have?

- Where should air filters be positioned and when? Are there any particular year groups, times of year or locations in the school?

- How could adults/young people in school be educated to use them correctly?

Finally, ensure students reflect on their learning by completing their CREST Discovery Passports.

Useful websites: public health education communication

[Preventing and Controlling infections](#)

[Coughs and sneezes poster](#)

[UK Health Security Agency](#)

Droplet Detectives: team presentations

Allow time for your students to plan and deliver their presentations. Encourage them to use their data, findings and suggestions from the three workshops to explain:

- If they feel the school should invest in air filters

APPENDIX A

CREST Discovery Award



Students should complete a [CREST Discovery Passport](#). When you assess the Passports to submit for the Awards, you will be recognising the skills that students have gained throughout their project.

Teacher's guidance

Teachers should observe students individually throughout the day and record any information which could be used to provide evidence of students meeting the following assessment criteria:

Self-management

Readiness to accept responsibility; flexibility; effective time management; motivation to improve own performance; confidence when tackling tasks

Team-working

Respecting others' work and views; working collaboratively; negotiating/persuading; contributing positively to discussions

Problem-solving

Analysing facts and circumstances to apply creative (imaginative) approaches in developing realistic, innovative and original solutions

Research

Acquiring new knowledge relevant to the task and applying it appropriately

Communication

Following written and verbal instructions (the brief); talking and listening to other team members; producing a structured presentation which relates to the original brief, and which reflects the creativity applied by the group during the day

Reflective practice

The ability to recognise which knowledge and skills have been gained, where they could have

worked more effectively and where they achieved/exceeded expectations.

CREST Discovery Passport

This is primarily intended as a self-reflection tool for students. Each student is assessed as an individual even when working within a team. Teachers should remind students at regular intervals to add comments to their own Passports. The Passports should be collected at the end of the day and may be used to confirm if a student has met the assessment criteria. This should only be needed if teachers have any concerns about the performance of individuals. It is not intended that teachers must review all CREST Discovery Passports after the event.

If a student has met the assessment criteria, they can receive a CREST Discovery Award. Register students and order certificates [here](#).

APPENDIX B

Curriculum links



Droplet Detectives has been designed to use flexibly with your students.

Whether you use the activities as a curriculum enrichment day, STEM club or to support your formal curriculum, the project will help to cover the following curriculum areas for students aged 10-14 years in England, Wales, Scotland and Northern Ireland.

England

Science (KS2) During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes and skills.

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

Science (KS3) Working scientifically students ask questions and develop a line of enquiry based on observations of the real world, alongside prior

knowledge and experience

Analysis and evaluation

- apply mathematical concepts and calculate results
- present observations and data using appropriate methods, including tables and graphs
- interpret observations and data, including identifying patterns and using observations,
- measurements and data to draw conclusions

Design and Technology (Years 5-6) Evaluate

- investigate and analyse a range of existing products
- evaluate their ideas and products against their own design criteria and consider the views of others to improve their work
- understand how key events and individuals in design and technology have helped shape the world

Design and Technology (KS3) Evaluate

- investigate new and emerging technologies
- test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups

understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists

APPENDIX B

Curriculum links



Scotland

Science

Biological systems - I have explored the role of technology in monitoring health and improving the quality of life.

Topical science - By considering current issues of science, learners increasingly develop understanding of scientific concepts and their capacity to form informed social, moral and ethical views.

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.

Technologies

Application of Engineering - I can extend my knowledge and understanding of engineering disciplines to create solution.

- I can identify and consider factors when developing design proposals.

The world around us is full of living things which depend on each other for survival.

I can identify the threats to

- development and health of organisms and recognise some natural defences, preventions and treatment

Computation is the foundation of our digital world.

- I can explain how data is stored and processed.
- I can effectively store and manipulate data to produce and give a visual form to useful information.

Wales

Science and Technology

Being curious and searching for answers is essential to understanding and predicting phenomena

Progression steps 3-4

- I can identify questions that can be investigated scientifically and suggest suitable methods of inquiry.
- I can suggest conclusions as a result of carrying out my inquiries.
- I can evaluate methods to suggest improvements

Design thinking and engineering offer technical and creative ways to meet society's needs and wants.

- I can draw inspiration to design from historical, cultural and other sources.
- I can creatively respond to the needs and wants of the user, based on the context and on the information collected.

Northern Ireland

Communication In Talking and Listening, children should be enabled to:

- listen to and take part in discussions, explanations, role-plays and presentations;
- communicate information, ideas, opinions, feelings and imaginings, using an expanding vocabulary;

In Writing, children should be enabled to talk about, plan and edit work.

Mathematics and Numeracy Handling Data

Thinking Skills and Personal Capabilities

- Managing Information;
- Thinking, Problem-Solving and Decision-Making;
- Being Creative;
- Working with Others;

APPENDIX C

Acknowledgements



All new CREST resources are developed and tested in consultation with educators from our **Engage Teacher Network**. We are hugely grateful for their valuable input.

Focus group participation and educator feedback

With thanks to all the Engage teachers who took part in the initial focus group session during the early scoping of this Discovery project, as well as those who reviewed draft versions of the materials during the development phase.

Testing

With special thanks to science teacher, Samuel Turner-Wilson, and the Year 9 students at UTC Derby Pride Park for their valuable input and feedback during the resource testing phase.

The Engage Teacher Network

Engage is a community of teachers in schools in challenging circumstances who share ideas, access inspiring resources and apply for grants to help bring science, technology, engineering and maths (STEM) to life for all young people.

To find out more and see if you are eligible to join, visit the [Engage](#) pages of the CREST website.

Engage Teacher Network



Managed by



crestawards.org
crest@britishscienceassociation.org

The British Science Association is the operating name and trademark
of the British Association for the Advancement of Science

Registered charity: 212479 and SC039236 © British Science Association