



Science Communication Activities **November 24-25th 2016** **CEITEC, Brno, Czech Republic**

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Science Communication Activities



✧ Specific examples:

- ✧ Highlighting events we have been involved in

- ✧ Examples from other scientists/organisations

✧ Brief history of Science Cafés

- ✧ General aims of such events

- ✧ Highlight different ways to deliver such events

✧ Opportunities for us all to get involved with

Objectives in Science Communication Activities



- ✧ Be clear about the objectives of any engagement activities and events – especially in relation to who your audience is
- ✧ Good objectives are SMART:
- ✧ S
- ✧ M
- ✧ A
- ✧ R
- ✧ T

Survival of the Fittest: Growth of Microbial Populations



- ✧ In 2009, we were awarded £1000 for an SGM Public Engagement with Microbiology Award
- ✧ For series of public engagement activities to celebrate anniversaries linked to Charles Darwin:
 - ✧ The bicentenary of his birth in 1809
 - ✧ His seminal manuscript, “On the Origin of Species”, was first published in 1859
- ✧ Scientists from the UEA and NRP engaged with the different parts of the local community
- ✧ Events were used to inform people about evolution and biodiversity – with a microbiological flavour!

Survival of the Fittest: Growth of Microbial Populations





 University of East Anglia

 School of Biological Sciences

 School of Medicine, Health Policy and Practice

Gut Flora Our Microbial Ecosystem

A human adult is made of ten trillion cells (10,000,000,000,000). Amazingly, we all contain ten times this number of helpful bacteria in our gut!

Although our intestine can be considered an extreme environment with a low pH and anaerobic conditions, it is an ecosystem containing many different microbes that make up our gut flora. These organisms help us to digest our food properly and they protect us from disease.

I'm a Home for Good bacteria?

Considered as a whole, the 100-1000 different species inside our gut act as a virtual organ. We have a symbiotic relationship with our gut flora in which both parties benefit. This symbiosis will have evolved by us, over a long period of time. The bacteria are provided with a safe environment and plenty of food. In turn, the bacteria help us by producing vitamins, stimulating our immune system, stopping the growth of unwanted bacteria, and helping us to get the most out of our food by breaking down complex substances. Considering the important role that our helpful ecosystem play in digesting our food, it is not surprising that our gut flora makes up 10% of the dry mass of faeces.

Symbiosis from Birth

Shortly after birth, our gut is rapidly colonised by bacteria, while inside the womb, our gastrointestinal tract does not contain any microbes. In our first two years of life, our gut flora is a change constantly depending on whether we have been vaginally or via caesarean, and whether we were breastfed or formula-fed. Vaginally born infants usually take only one month for their microbes to become well-established because they are exposed to their mother's gut microbes on delivery, however the gut flora of infants delivered by caesarean section usually take about 6 months to become well established. By our second year of life, after the introduction of solid food and weaning, our gut flora remain relatively constant for the rest of our lives.

Carbohydrate Fermentation & Protection from Disease

Gut bacteria are organisms that we eat produce to help break down carbohydrates – such as certain fibres, starch and sugars – in short-chain fatty acids (SCFA). This allows us to use energy that would otherwise go unused; bacteria that are not exposed to helpful gut bacteria need to consume 10% more food than their normal counterparts just to offset the extra weight. SCFA provide much useful energy, they also promote the growth of gut cells and help us to absorb water.

Our gut flora provides more benefits by preventing harmful bacteria from colonising our intestine – this is called the "barrier effect". They prevent us from becoming infected by harmful bacteria, such as *Clostridia* or *Shigella*, by creating the mucous lining of the intestine. Our helpful symbiotic partners also reach more successful in this ecosystem, in comparison with foreign bacteria, because they are able to acquire exactly the right amount of nutrients, which thereby keeps out the competitors. The production of SCFA also lowers the pH in the colon, which prevents many harmful bacteria from growing. Some scientists also claim that SCFA can reduce the risk of inflammatory bowel disease.

What Happens When We Take Antibiotics

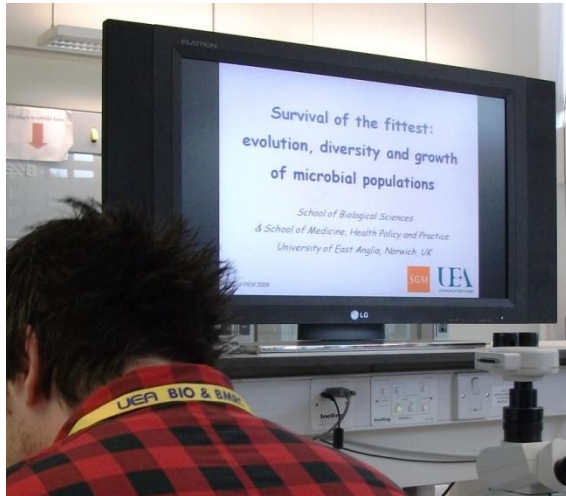
We often take antibiotics to get rid of the bad bacteria that make us ill, but in doing so, we often wipe out our helpful symbiotic gut flora along with the "bad" ones. Although this helps us to quickly rid of the bad bacteria, we also lose our good microflora, leaving lots of space in our intestine for new bad bacteria to make a home. This is why many of us usually don't "bounce back" after taking antibiotics.

Evening bad bacteria to establish without managing to kill them has led to the evolution of antibiotic resistance. Once a bacterium has evolved resistance to a drug to pass the gene for resistance to its friends, and resistance is passed quickly through a population. This is why we have so much antibiotic resistance "super bugs" such as MRSA. It took us a long time to realise our relationship with our gut flora, we should appreciate the benefits they bring to us.

Our gut microbes are an important part of what keeps us healthy, why is this so?



 Society for Microbiology



Survival of the Fittest: Growth of Microbial Populations

SURVIVAL OF THE FITTEST

THE RECENT CELEBRATIONS

of anniversaries associated with Charles Darwin led many scientists to explore new ways to discuss the importance of evolution. Scientists from the University of East Anglia (UEA) and Norwich Research Park designed a wide range of events that engaged with the local community. Realizing that microbes provide some of the best evidence for Darwin's seminal theory, we developed a series of events to show how microbes can quickly respond to changes in their surroundings. These events were designed to illustrate the fundamental principles behind evolution, such as 'survival of the fittest' – the microbes that adapt the most quickly and the most successfully are the ones that survive and thrive. This ability of microbes to evolve has relevance to our everyday life, for example in the development of antibiotic resistance, bioremediation and the potential for simple organisms to inhabit environments that are extremely hostile.



Visitors at the Forum in Norwich, L. & R. Bowater

With funding provided by an SGM Public Engagement in Microbiology Award, we designed and developed a series of interactive exhibits that we were able to mix and match to engage with schoolchildren, science enthusiasts and the wider public. The activities that the interactive exhibits supported also provided opportunities for academic lecturers, researchers and UEA students with an interest in public engagement to participate and develop their skills in this area. Part of the project was a suite of 5 posters that were designed by students enrolled on UEA's BSc in Microbiology. Other staff and students helped to create and present the hands-on elements, which included microscopes and agar plates that showed the wonderfully different morphologies, colours and smells that have evolved within the microbial world. Children were encouraged to 'evolve a microbe' using modelling clay and to 'grow their own bugs' from handprints. We also designed a computer presentation to show how simple

mutations can lead to dynamic bacterial populations that can quickly adapt to changes in the environment.

Students that took part in the events commented that 'it was an enjoyable and valuable learning experience' and 'it was a positive surprise to see how much I learnt from other people both as a science communicator, and just on an everyday level'.

The plan was to take the interactive exhibits to three different events throughout Norwich. However, the success and flexibility of the exhibits has meant that we have also continued to develop and deliver them at other events.

The first exhibition was held at UEA as part of a



THE YORK FESTIVAL of Science and Technology is a week-long event aiming to bring Science to Life for all ages. The Centre for Immunology and Infection (CII), a joint venture between the Hull York Medical School and the Department of Biology at the University of York, has again promoted public understanding of microbiology at one of the Festival's showcase events, Science Discovery Days. Held at the famous National Railway Museum, this event allows children and adults to get hands-on experience of contemporary issues in science. This is the second year that the CII participated, and we were



CIL staff at the York Festival, M. van der Woude

eager to build upon the previous year's success to demonstrate key aspects of our research in a light-hearted but educational format.

The location of our stand, right in front of one of the main entrances, boded well for a large number of potential visitors. Also working in our favour was a team of enthusiastic CII scientists to guide guests of all ages through the wide selection of original activities.

For many of the youngest visitors, the chance to dress up as a scientist and use the plethora of crayons to colour-in pictures of microbes proved irresistible. No doubt many family photo albums are now enriched with pictures of future Nobel Prize winners, and fridges are decorated with colourful bacteria and parasites.

Another popular attraction for our younger visitors was the

**— TRAINS, GAMES, MICROBES AND MICROSCOPES —
A WINNING RECIPE FOR A GREAT DAY!**

weekend of events entitled 'Darwin@UEA'. Almost 80 year 9 students visited the University on the Friday and well over 200 members of the public visited on the Saturday.

For the second event we took part of the exhibit to the Maddermarket Theatre in Norwich as part of a regular series of Science Café events. The warm summer evening helped to draw in the crowds who were able to take advantage of the bar refreshments on offer while discussing the growing problem of microbes evolving and developing antibiotic resistance.

The third event was part of the annual Cells Alive event, which takes place on the final

Saturday of September. By locating this free event in Norwich's award-winning Forum centre, it has developed a group of loyal visitors who look forward to attending it, but the location also ensures that it catches the passing trade of families, pensioners, teenagers and visitors to the city. Cells Alive attracted more than 600 visitors over the course of the day and a huge variety of novel microbes (newly evolved in modelling clay!) made their way out of the Forum.

As a result of this project, we have produced several interactive exhibits that have continued to be used at a wide variety of public engagement events delivered by Norwich scientists. The contemporary and flexible nature of the exhibits has allowed us to plan using them again at events in the near future to highlight the significance and fascination of research involving microbiology.

DRS LAURA and RICHARD BOWATER are Senior Lecturers at University of East Anglia (email laura.bowater@uea.ac.uk, r.bowater@uea.ac.uk)



Children at an event held in laboratories at the UEA, L. & R. Bowater

Survival of the Fittest: Growth of Microbial Populations



- ✧ Events showed how quickly microbes can respond to their surroundings, illustrating some of the best evidence for Darwin's seminal theory
- ✧ The events illustrated the principles behind the description of evolution as “survival of the fittest”: the microbes that adapt most quickly and most successfully are the ones that survive and thrive
- ✧ Highlighted relevance to everyday life, such as development of antibiotic resistance, bioremediation and the potential for organisms to inhabit hostile environments

Survival of the Fittest: Growth of Microbial Populations



Gut Flora Our Microbial Ecosystem

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Although our intestine can be considered an extreme environment with a low pH and powerful antibiotics, it is an ecosystem containing many different microbes that make up our gut flora. These organisms help us to digest our food properly and they protect us from disease.

I'm a Home for Good Bacteria?

Considered as a whole, the 100-200 different species within our gut make up a rich and diverse ecosystem. Some are harmful, but most are helpful. The bacteria are provided with a safe environment and plenty of food. In turn, the bacteria help us by providing vitamins, stimulating our immune system, stopping the growth of unwanted bacteria, and helping us to get the most out of our food by breaking down complex molecules. Considering the important role that our helpful microorganisms play in digesting our food, it is not surprising that our gut flora makes up 10% of the dry mass of humans.

Symbiosis from Birth

Shortly after birth, we get our regular colonisation by bacteria, which we take from our mother. Our gut flora is then shaped by our diet. In the first year of life, our gut flora can change dramatically. It is not until we are about 3 years old that our gut flora is stable. It is then that we start to get our regular colonisation by bacteria, which we take from our mother. Our gut flora is then shaped by our diet. In the first year of life, our gut flora can change dramatically. It is not until we are about 3 years old that our gut flora is stable. It is then that we start to get our regular colonisation by bacteria, which we take from our mother.

Carbohydrate Fermentation & Protection from Disease

Our gut bacteria are not just passive residents. They help to break down complex molecules into simpler ones that we can use for energy. They also help to protect us from disease by producing antimicrobial compounds that kill or inhibit the growth of harmful bacteria.

What Happens When V

When we eat, we introduce new bacteria into our gut. Some of these bacteria are helpful, but some are harmful. Our immune system works to keep the balance of our gut flora in check. If the balance is disrupted, we can get sick. This is why it is important to eat a healthy diet and to avoid unnecessary antibiotics.

Our gut flora is what keeps us healthy, why is this so?

Symbiosis A Beneficial Relationship?

Mention evolution and we usually think about organisms competing with each other. Yet another important driving force for evolution is the way that organisms have worked together, through a beneficial relationship called symbiosis.

Symbiosis all around us

Symbiosis is a relationship between two different organisms. It can be mutualistic, commensal, or parasitic. Mutualistic symbiosis is a relationship where both organisms benefit. Commensal symbiosis is a relationship where one organism benefits and the other is not affected. Parasitic symbiosis is a relationship where one organism benefits and the other is harmed.

Symbiosis on the inside

Our gut flora is a classic example of mutualistic symbiosis. The bacteria in our gut help us to digest our food and produce vitamins. In return, we provide them with a safe environment and plenty of food. This is a mutually beneficial relationship that has evolved over millions of years.

Symbiosis throughout

Symbiosis is not just limited to the gut. It is found everywhere. For example, the relationship between a clownfish and a sea anemone is a classic example of mutualistic symbiosis. The clownfish gets protection from the sea anemone, and the sea anemone gets nutrients from the clownfish.

We all need one another

Without our gut flora, we would not be able to survive. This is why it is so important to take care of our gut health. Eating a healthy diet and avoiding unnecessary antibiotics are the best ways to keep our gut flora in good health.

Viruses Evolution & Humanity

They're so small we can't see them with an ordinary microscope and scientists are unsure whether they are 'alive'. Yet viruses are the most abundant biological entity on our planet.

Viruses, Evolution & Humanity

Viruses are tiny particles that can only be seen with an electron microscope. They are made of a small amount of genetic material surrounded by a protein coat. They can only replicate inside a host cell. This makes them very different from other organisms.

Smallpox & the Advent of Vaccines

Smallpox is a deadly disease that has killed millions of people. It is caused by a virus. The discovery of vaccines has helped to prevent the spread of many diseases, including smallpox. Vaccines work by introducing a small amount of the virus into the body, which then triggers an immune response.

HIV & Swine Flu

HIV is a virus that attacks the immune system. It can lead to AIDS. Swine flu is a type of influenza that is caused by a virus. It is more severe than the common flu. Both of these viruses are examples of how viruses can affect human health.

Why Viruses are so Successful

Viruses are so successful because they are so small and they can replicate so quickly. They can also hide inside host cells, where they can avoid the immune system. This makes them very difficult to fight.

How do viruses stay one-step-ahead of their host?

Viruses have evolved many ways to stay one-step-ahead of their host. Some viruses can change their genetic material to avoid detection. Others can hide inside host cells for long periods of time before they start to replicate.

Astrobiology In Search of Life Elsewhere

What would life be like in a far-away solar system? Is life evolving on other planets? These questions are central to the science of astrobiology.

In Search of Life Elsewhere

Astrobiology is the study of life in the universe. It is a multidisciplinary field that combines biology, chemistry, physics, and astronomy. Scientists are looking for signs of life on other planets and moons. They are also studying the conditions that might allow life to exist elsewhere.

Could Life Have Started on Another Planet?

Some scientists believe that life might have started on another planet and then spread to Earth. This is called panspermia. They think that life could have been carried to Earth by meteorites or other celestial bodies.

Mars, Europa, and the Saturn Moons

Mars, Europa, and the moons of Saturn are some of the most likely places where we might find life. Scientists are sending rovers and probes to these places to look for signs of life. They are also studying the conditions that might allow life to exist there.

Astrobiology & The Origin of Life

Astrobiology is also concerned with the origin of life. Scientists are trying to understand how life might have started on Earth. They are studying the conditions that might have allowed life to emerge from non-living matter.

Do you think life has emerged elsewhere in the universe? Or will it in the future?

This is one of the most important questions in astrobiology. Scientists are working hard to answer it. They are using a variety of methods to look for signs of life elsewhere in the universe.

Extremophiles Intolerable Conditions?

Imagine living in deep sea vents, acid mines or within microscopic spaces in rocks... doesn't sound very cosy, does it? Well for many extremophiles, this is home.

Extremophiles are organisms that flourish under conditions that most organisms could not tolerate. Some live in extreme temperatures, some live in acidic conditions, and some can survive in nuclear waste.

Beautiful diversity

Extremophiles are incredibly diverse. They can be found in a wide range of environments, from deep sea vents to acid mines. They have evolved many different ways to survive in these extreme conditions.

There are Many Ways to Make a Living

Extremophiles have many different ways to make a living. Some are autotrophic, meaning they can make their own food. Others are heterotrophic, meaning they need to eat other organisms. This shows that life can exist in a wide range of ways.

Living Under Pressure

Some extremophiles live under high pressure. They are found in deep sea vents and other high-pressure environments. They have evolved ways to survive under these conditions.

The Ultimate Heat Nut

Some extremophiles live at very high temperatures. They are found in hot springs and other high-temperature environments. They have evolved ways to survive at these temperatures.

Why are most life forms suited to some environments but not others?

This is a question that scientists are trying to answer. They are studying the adaptations that allow organisms to survive in different environments. This will help us to understand the limits of life on Earth and elsewhere.

Survival of the Fittest: Growth of Microbial Populations

Profile of Your Microbe

Your name

The name of your bacterium

Does it cause disease?


Does it help cycle nutrients?

Draw a Picture of Your Microbe

Evolve a Microbe!



Survival of the Fittest: Growth of Microbial Populations



Darwin@UEA

As Part of the 150th anniversary of the publication of *On the Origin of Species* and the 200th anniversary of Charles Darwin's birth the School of Biological Sciences at the UEA will host two schools engagement days.

Thursday 9th & Friday 10th July | School of Biological Sciences, UEA


Each session will include the following activities:

Lecture : 'Charles Darwin – His life, science and legacy'

Displays and interactive demonstrations on the following themes:

- A Darwin Biography
- The Diversity of living organisms
- Embryogenesis and patterns of development in animals
- A bugs life – How bacteria adapt to diverse environments
- Molecules, mutations and evolution

Session times:
Session I: 9:30 – 12:00 noon
Session II: 12:30 – 15:00pm



UEA
University of East Anglia

To register for this event please contact Katie Barber,
Email: katie.j.barber@uea.ac.uk Tel: 01603 593115

Objectives of “Survival of the fittest”, SGM PEM



✧ Overall aim was to develop exhibits/activities that would *✓ Informative; ✓? Interesting; ✓ Engaging*

✧ Objectives included:

✧ Increase selection *?? Although information provided, did people learn anything from it? Need a more formal evaluation....*

✧ High *✓ Information presented in several formats*

✧ Development range *✓ Posters have been used for several events, including departmental Visit and Open Days*

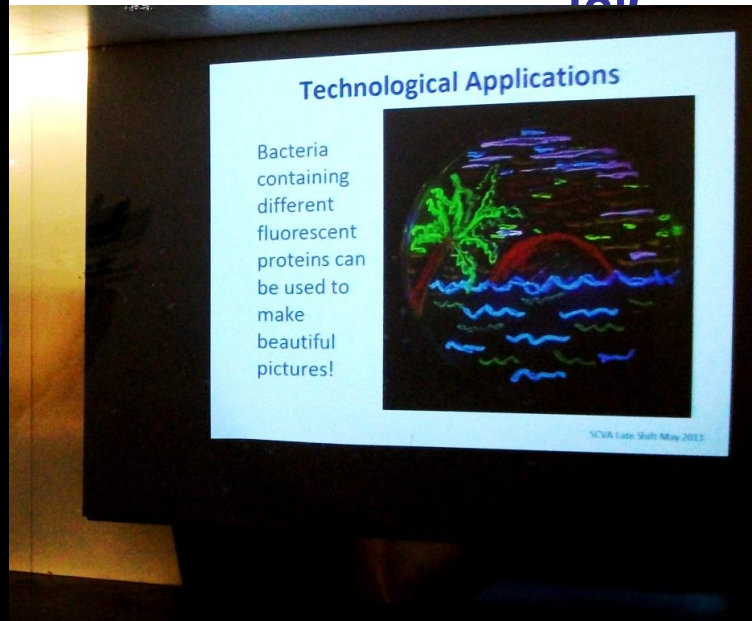
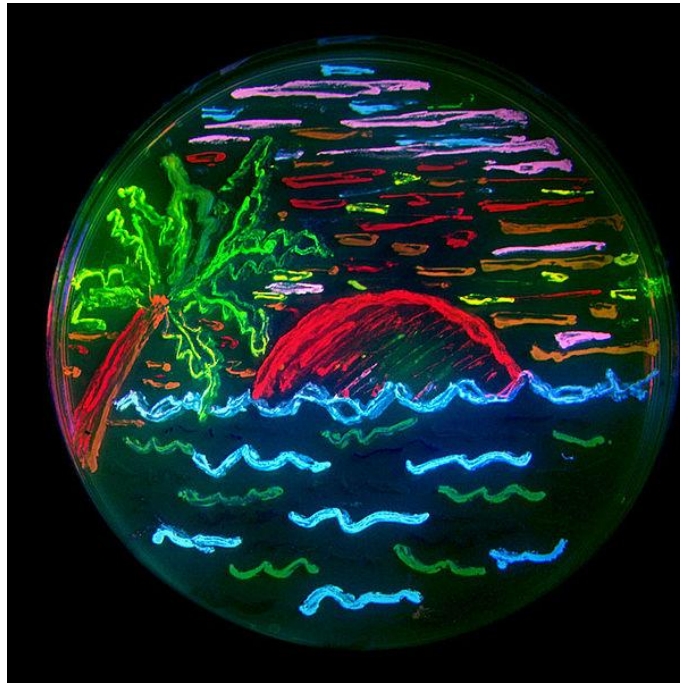
✧ *✓ “Fantastic experience! Helped me to think about science in a different way” – Jaeger Hamilton*

Were the objectives met?

Engaging with Artists

- ✧ Scientists need to engage with non-traditional audiences
- ✧ UEA is home to the Sainsbury Centre for Visual Arts (SCVA) – an inspirational public art museum
- ✧ We are keen to build links with the SCVA, especially to use their skills to discuss our science in different ways
- ✧ Take time to build relationships with experts who will help achieve your aims
- ✧ Focus on topics that have a broad interest – antibiotic resistance, species biodiversity, etc.

Engaging with Artists



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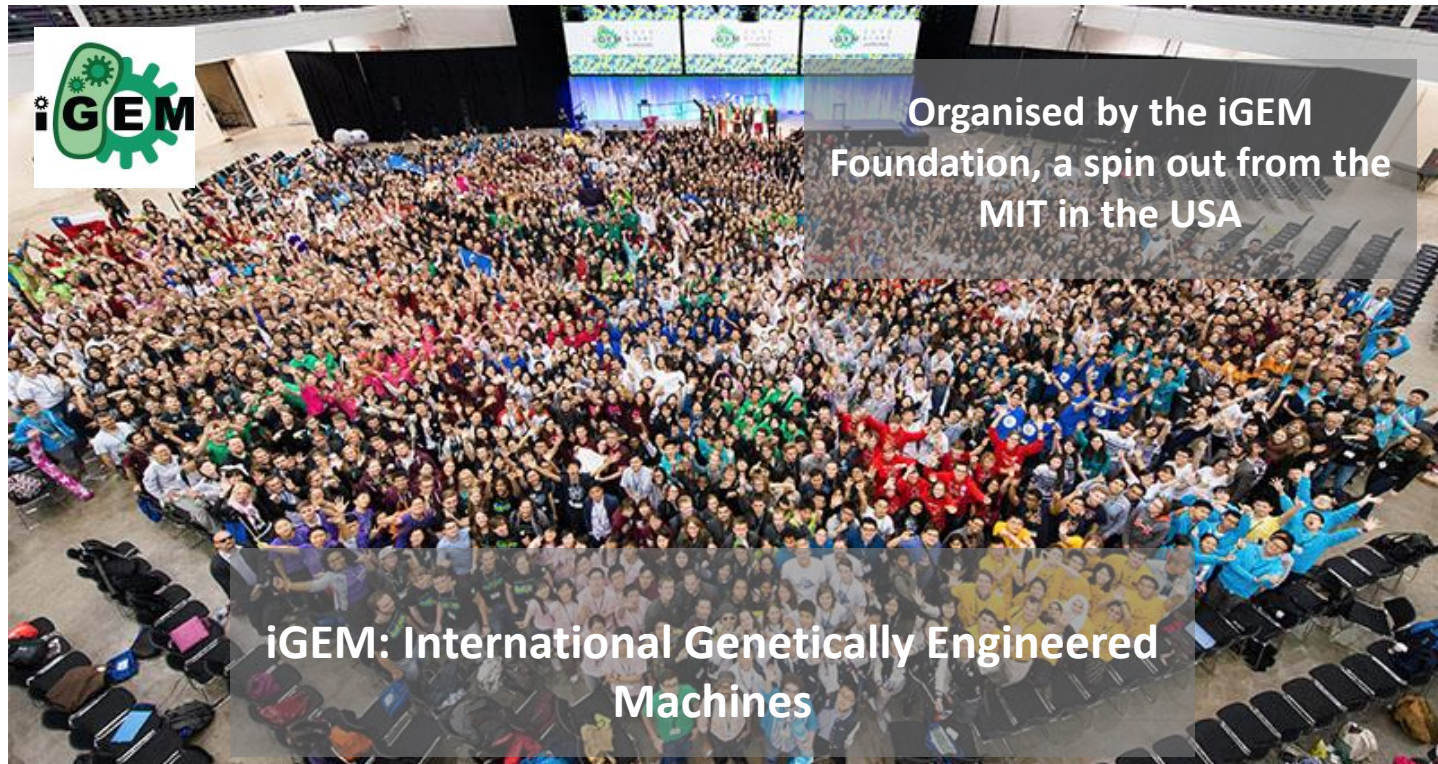
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Engaging with Artists



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iGEM: What is it?



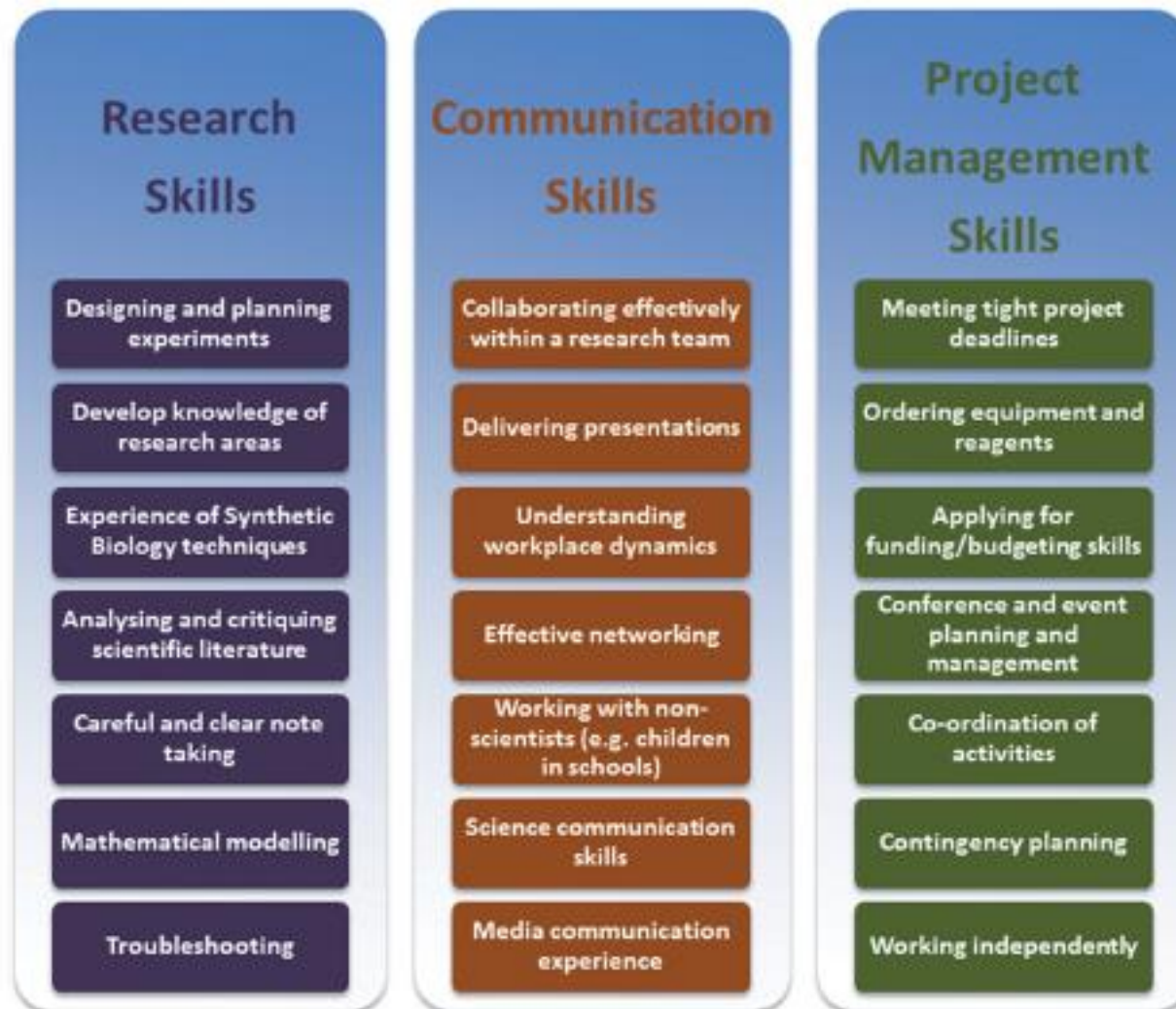
A Global Synthetic Biology Competition for University Students – usually “research-intensive”

Leads to Jamboree at end of projects

What is Involved in iGEM?

- ✧ The team (Students + Advisers) develop a Synthetic Biology project that must be completed within each competition period
 - ✧ Teams compete to win medals (**Gold**, Silver or **Bronze**) and prizes
- ✧ Genetic engineering must be performed within the project, following quite strict criteria
 - ✧ Must involve Human Practices (outreach) and consideration of ethical issues of the project

Skills Developed in iGEM Projects



NRP-UEA iGEM Teams



NRP-UEA iGEM Teams



NRP-UEA iGEM Teams



Outreach of NRP-UEA iGEM Teams



THE HEWETT SCHOOL

NRP-UEA iGEM 2014 Team



CUT EVENT



SCIENCE CAFE



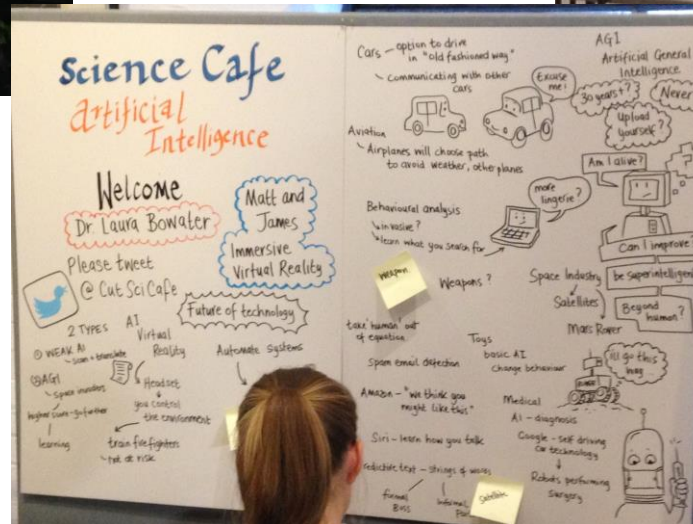
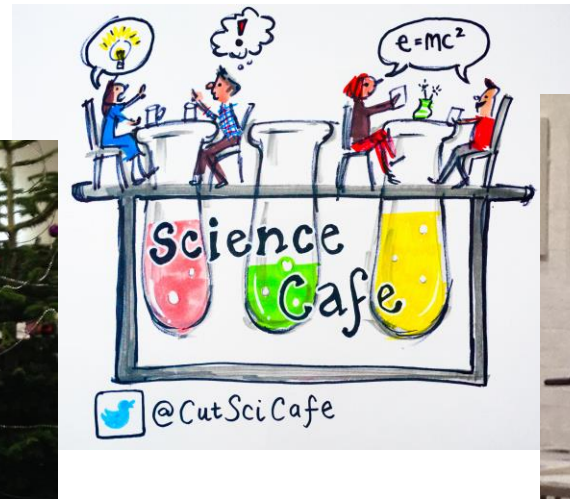
ETHICS OF PUBLIC CONSULTATION

Halesworth, Suffolk, UK

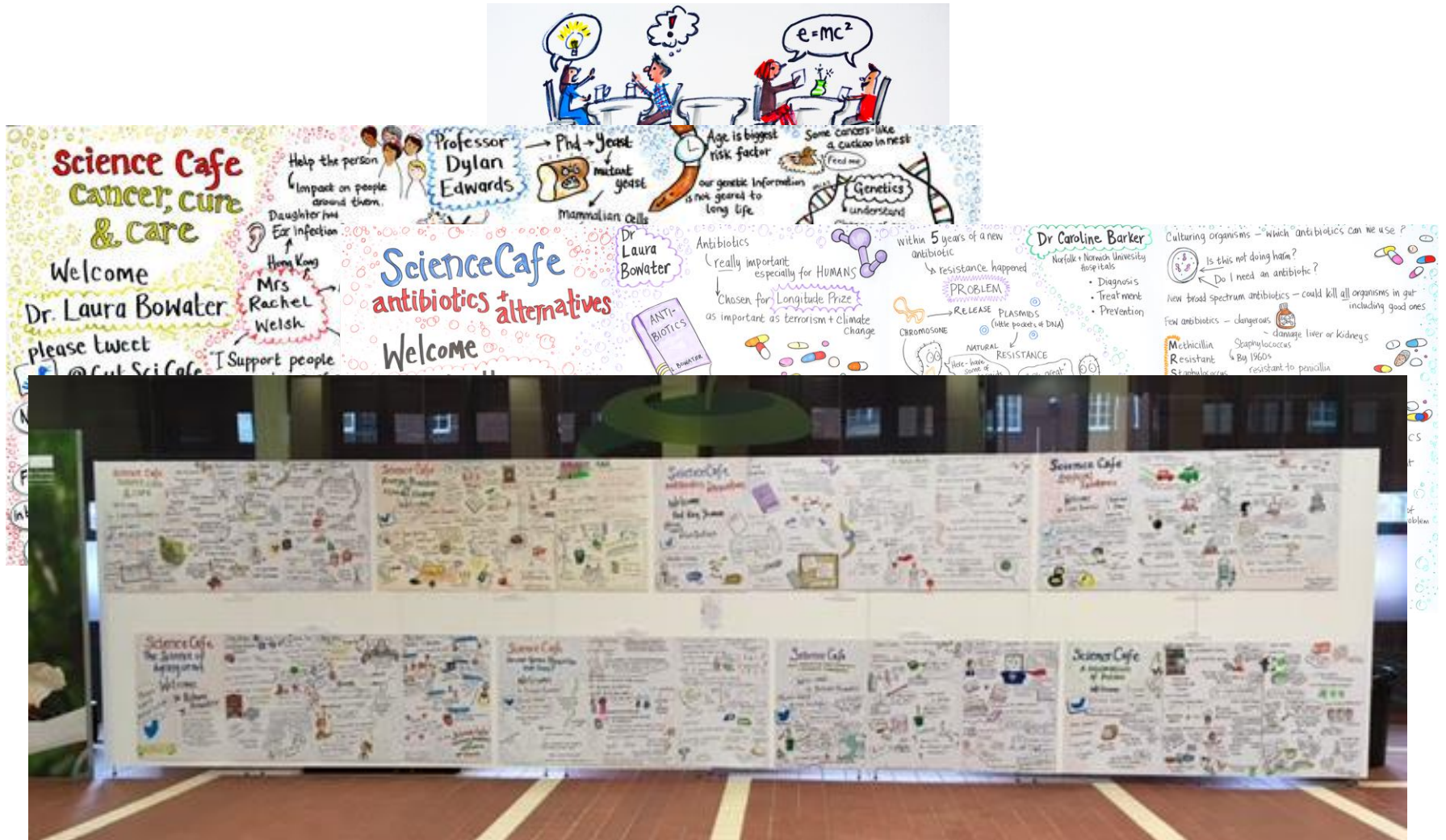
- ✧ Halesworth is a market town in north east Suffolk
- ✧ Steeped in the history of brewing, malting and agriculture
- ✧ It is home to The Cut Arts Centre - performing arts in a converted Maltings



The Cut Science Café



The Cut Science Café

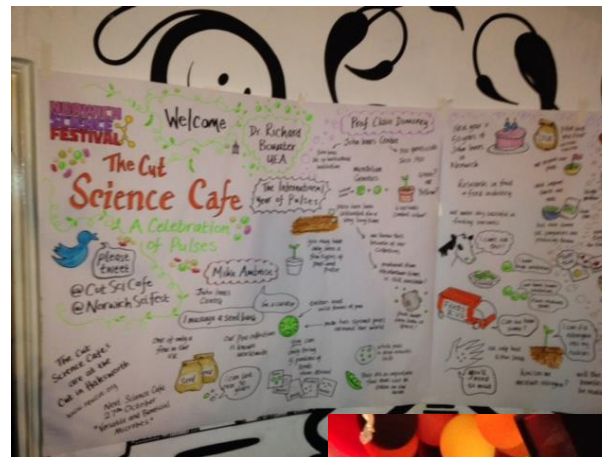


Different Types of Science Cafés

- *Pint of Science, Norwich 2016*

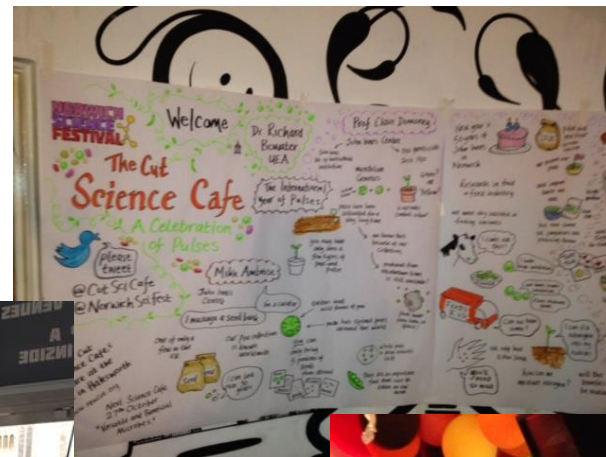


- *Norwich Science Festival 2016*



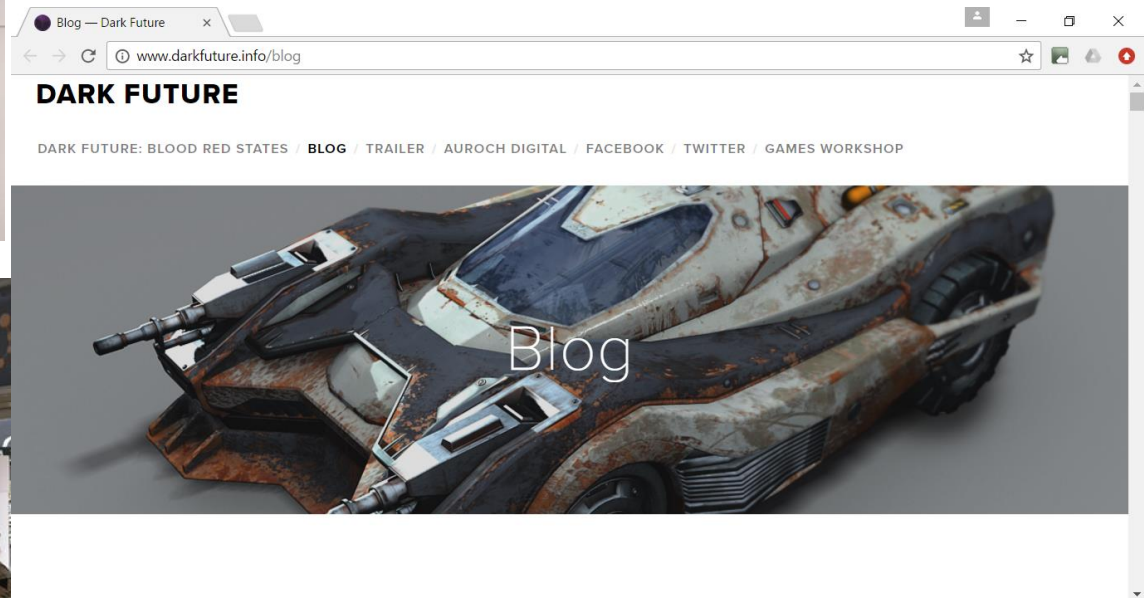
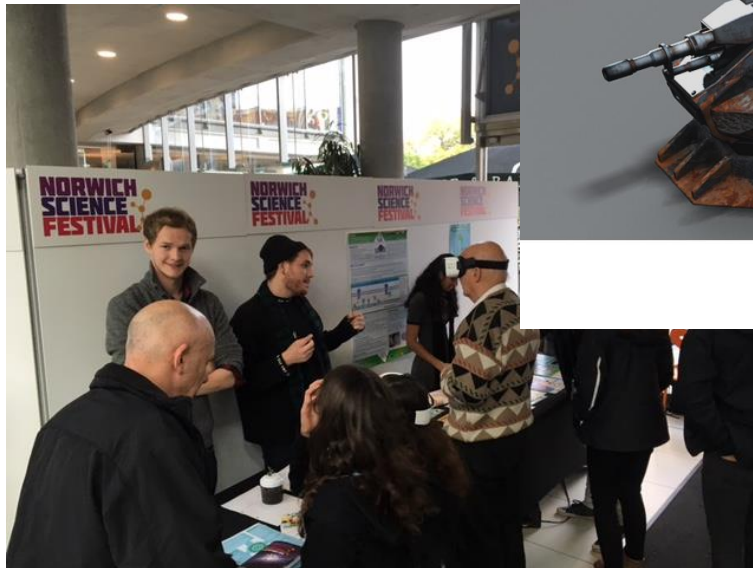
Norwich Science Festival 2016

- Norwich Science Festival 2016*



Virtual Science Realities

- Auroch Digital: Dark Future*



Summary



- ✧ Lots of different opportunities to get involved in science communication activities
- ✧ Consider the aims of such events
- ✧ Can engage and link to a wide range of different audiences
- ✧ They take time, but can be very rewarding

Acknowledgements

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- Tom Clarke (BIO) Matt Hutchings (BIO)
- Tom Shakespeare (MED) Colwyn Thomas (BIO)
- Mark Wilkinson (MED) Kay Yeoman (BIO)

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