



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



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. Realising 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, I. & 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

CII 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.

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Children at an event held in laboratories at the UEA, I. & 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

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 intestines can be considered an extreme environment with a low pH and anaerobic conditions, it is an amazing ecosystem containing many different microbes that make up our gut flora. These organisms help us 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 in our gut can be divided into two groups: those that are always present and those that are not. The bacteria that are always present are called the core microbiome. They are the bacteria that are always present in the gut, and they are the ones that are most important for our health. The bacteria that are not always present are called the transient microbiome. They are the bacteria that are only present in the gut for a short time, and they are the ones that are most likely to cause disease.

Symbiote from Birth

Shortly after birth, we get our microbiome from bacteria, which helps us digest our food and protect us from disease. In our first two years of life, our gut flora is shaped by diet, environment, and genetics. It is not until we are about 10 years old that our gut flora is truly established. This is because we are exposed to many different environments and people, which introduces new bacteria to our gut. Our gut flora is constantly changing, and it is this change that helps us adapt to our environment.

Carbohydrate Fermentation & Protection from Disease

Get bacteria to eat requires that we eat a particular diet. Bacteria need carbohydrates to grow, and they need to eat them. The bacteria in our gut ferment carbohydrates and produce short-chain fatty acids (SCFAs). These SCFAs are important for our health because they help us digest our food and protect us from disease. They also help us maintain a healthy weight and reduce our risk of heart disease.

What Happens When V

When we eat a diet that is high in carbohydrates, our gut flora produces more SCFAs. This is good for our health because SCFAs help us digest our food and protect us from disease. However, if we eat a diet that is high in fat and low in carbohydrates, our gut flora produces fewer SCFAs. This is bad for our health because it can lead to obesity and heart disease.

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

Microbiology

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 or more organisms that live together. It can be mutualistic, commensal, or parasitic. Mutualistic symbiosis is the most common type, and it is the one that we are most familiar with. In mutualistic symbiosis, both organisms benefit from the relationship. For example, the bacteria in our gut help us digest our food, and we provide them with a home and food. Commensal symbiosis is a relationship in which one organism benefits from the relationship, but the other organism is not affected. For example, the bacteria on our skin help us protect ourselves from disease, but we are not affected by them. Parasitic symbiosis is a relationship in which one organism benefits from the relationship, but the other organism is harmed. For example, a parasite that lives inside a host organism can cause disease and even death.

Symbiosis on the inside

Our gut is home to trillions of bacteria, and these bacteria are in a symbiotic relationship with us. They help us digest our food and protect us from disease. Without them, we would not be able to survive. This is a classic example of mutualistic symbiosis. The bacteria in our gut are not just passive residents; they are active participants in our health. They produce SCFAs, which are important for our health, and they help us maintain a healthy weight and reduce our risk of heart disease.

Organisms composed of complex cells are called eukaryotes. Eukaryotes have a nucleus, which contains their DNA. Prokaryotes, on the other hand, do not have a nucleus. They are much simpler organisms, but they are also very important. Bacteria, for example, are prokaryotes, and they are the most abundant organisms on Earth. They play a crucial role in many ecosystems, and they are also important for our health. The bacteria in our gut are prokaryotes, and they are essential for our survival.

Symbiosis & Evolution

The theory that the relationship and interdependence of organisms is a driving force for evolution is called symbiogenesis. This theory suggests that new species can arise through the process of symbiosis. For example, the mitochondria in our cells are thought to have originated as free-living bacteria that were taken up by a larger cell. Over time, these bacteria became integrated into the cell, and they now play a crucial role in our energy production. This is a classic example of symbiogenesis.

We all need one another

Microbiology

Virus 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.

A virus can contain a DNA or RNA genome (DNA is a double helix structure to DNA, that can be single or double stranded, wrapped in a protein jacket. One to three hundred, viruses are entirely dependent on their host.

Viruses, Evolution & Humanity

Viruses are fascinating entities with a long history. They are the most abundant biological entity on our planet, and they are also one of the most diverse. Viruses have been found in every environment, from the deepest ocean to the highest mountains. They are also found in every organism, from the smallest bacterium to the largest animal. This is because viruses are so small and so simple that they can easily enter a cell and hijack its machinery. They use the cell's resources to make more viruses, which then go on to infect other cells. This is how viruses spread and evolve.

Smallpox & The Advent of Vaccines

Smallpox is a deadly disease, caused by the variola virus, which was responsible for 500,000 deaths per year in Europe throughout the 18th century. In 1789 Edward Jenner noticed that milkmaids who were exposed to the cowpox virus did not catch smallpox, and he used the knowledge to develop the first ever vaccine of smallpox. This was the beginning of modern medicine, and it led to the development of many other vaccines. Today, smallpox has been eradicated, and it is one of the few diseases that have been completely eliminated from the world.

HIV & Sars-Cov-2

Although the evolution of complex molecules is a major step forward in our ability to protect ourselves from the world, this was not a step forward for our species. For example, the human immunodeficiency virus (HIV) was identified as a major cause of AIDS in 1981. It was first identified in 1981, and it has since become a major global health problem. HIV is a retrovirus, which means that it has an RNA genome. It attacks the immune system, and it can lead to AIDS if it is not treated. Sars-Cov-2 is another retrovirus, and it is the cause of COVID-19. It is a new virus, and it is still in the early stages of our understanding. However, it is clear that viruses are a major force in the evolution of life on Earth.

Why Viruses are so Successful

Viruses are so successful because they are so small and so simple. They can easily enter a cell and hijack its machinery. They use the cell's resources to make more viruses, which then go on to infect other cells. This is how viruses spread and evolve. They are also very diverse, and they are found in every environment. This makes them a major force in the evolution of life on Earth.

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

Microbiology

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

Some astrobiologists think that life may have originated elsewhere in the universe, and that it has since spread to Earth. This is the panspermia theory. It suggests that life-bearing molecules, such as amino acids, can be carried to other planets by meteorites or comets. This theory is supported by the discovery of amino acids in meteorites, and it is also supported by the discovery of organic molecules on Mars. However, there is still a lot of debate about whether life has actually been found elsewhere in the universe.

Mars, Europa, and the Saturn Moons

Mars is the most Earth-like planet in our solar system, and it is the one that we are most likely to find life on. There is evidence of water on Mars, and there is also evidence of a once-thriving environment. The Mars rovers have found many interesting things, and they have also found evidence of a once-thriving environment. Europa is another planet that is thought to have a subsurface ocean, and it is also thought to have a once-thriving environment. The Saturn moons, Titan and Enceladus, are also thought to have subsurface oceans, and they are also thought to have a once-thriving environment.

Astrobiology & The Origin of Life

The origin of life is one of the most important questions in science, and it is also one of the most difficult. There are many different theories about how life originated, and there is still a lot of debate about which one is correct. Some scientists think that life originated on Earth, while others think that it originated elsewhere in the universe. The panspermia theory is one of the most popular theories, and it is also the one that is most supported by evidence. However, there is still a lot of work to be done to understand the origin of life.

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

Microbiology

Extremophiles Intolerant 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.

Beautiful diversity

Extremophiles are organisms that live in extreme environments. They are found in places that we would never think of as habitable, such as deep sea vents, acid mines, and within microscopic spaces in rocks. There are many different types of extremophiles, and they are also very diverse. Some extremophiles are able to live at very high temperatures, while others are able to live at very low temperatures. Some are able to live in very acidic environments, while others are able to live in very alkaline environments. This diversity is what makes extremophiles so interesting, and it is also what makes them so important for our understanding of life on Earth.

There are Many Ways to Make a Living

Extremophiles have many different ways of making a living. Some are chemotrophs, which means that they get their energy from inorganic chemicals. Others are phototrophs, which means that they get their energy from light. Some are autotrophs, which means that they can make their own food. This diversity is what makes extremophiles so interesting, and it is also what makes them so important for our understanding of life on Earth.

The Ultimate Hard Nut

The ultimate hard nut is the question of whether life exists elsewhere in the universe. This is one of the most important questions in science, and it is also one of the most difficult. There are many different theories about whether life exists elsewhere, and there is still a lot of debate about which one is correct. The panspermia theory is one of the most popular theories, and it is also the one that is most supported by evidence. However, there is still a lot of work to be done to understand whether life exists elsewhere in the universe.

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

Microbiology

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



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

✧ High *√ Information presented in several formats* life

✧ Develop rang *√ Posters have been used for several events, including departmental Visit and Open Days*

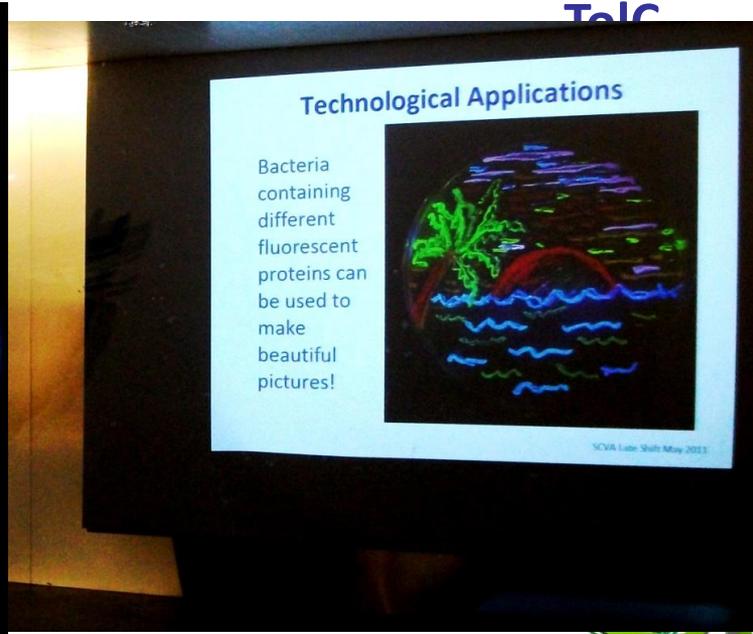
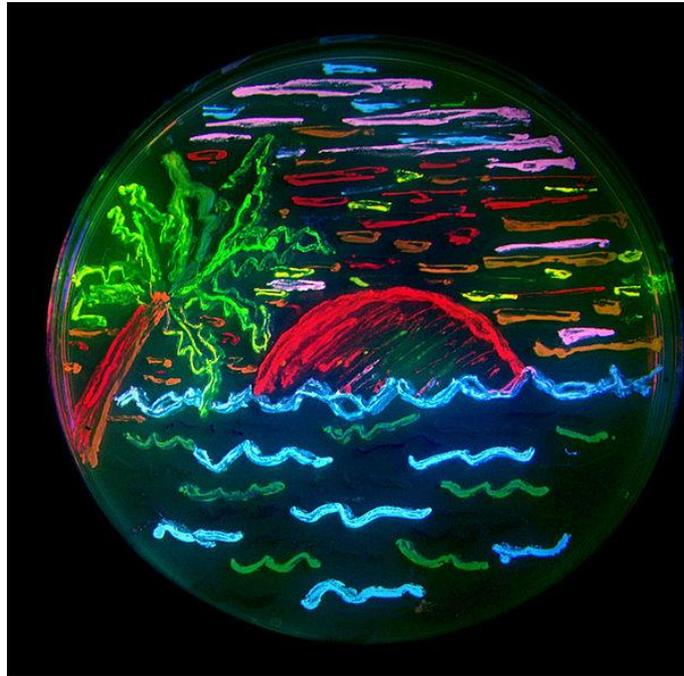
✧ *√ “Fantastic experience! Helped me to think about science in a different way” – Jaeger Hamilton* ce for

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



TelC

conformations)

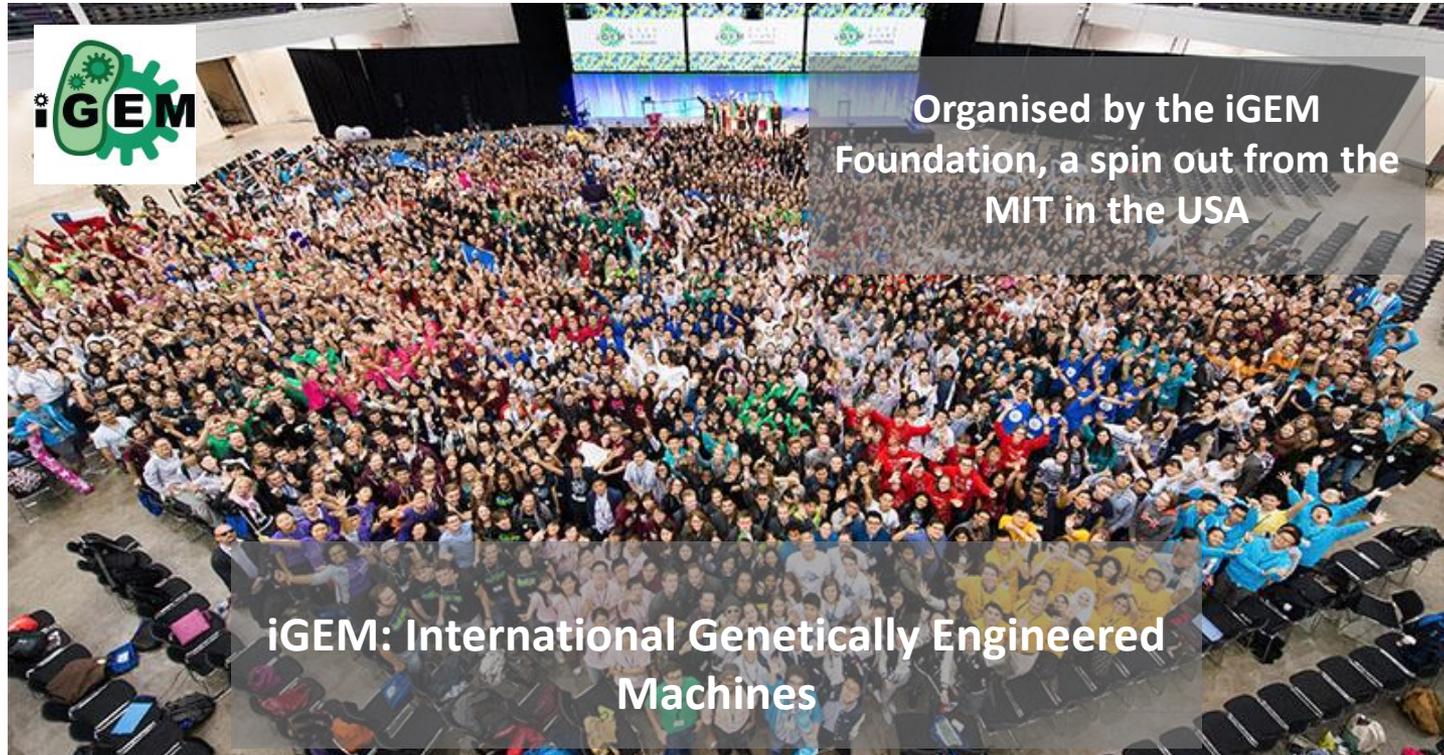
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Engaging with Artists



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iGEM: What is it?



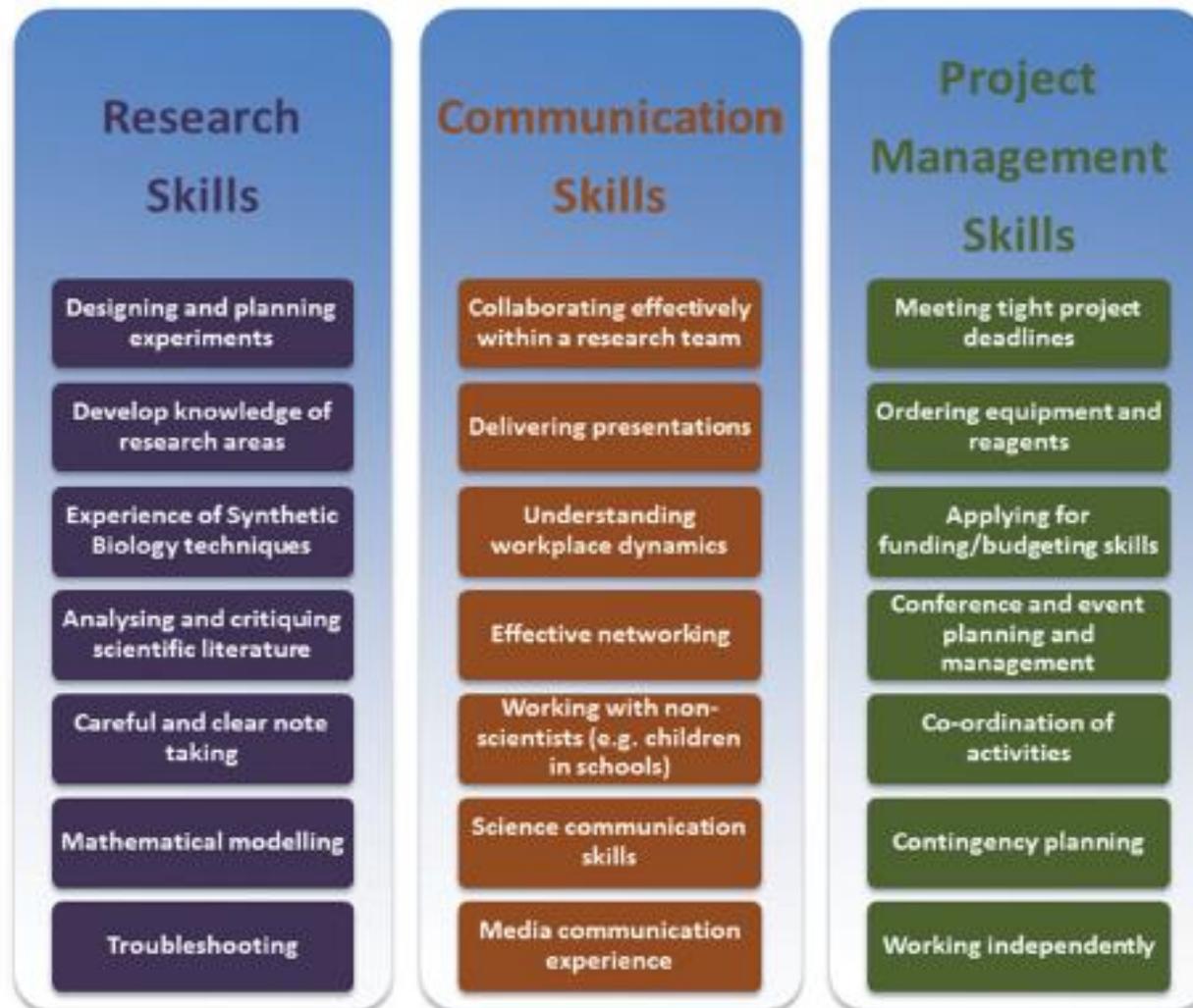
A Global Synthetic Biology Competition for University Students – usually “research-intensive”

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



2015



2016



Outreach of NRP-UEA iGEM Teams



THE HEWETT SCHOOL

NRP-UEA iGEM 2014 Team



CUT EVENT



SCIENCE CAFE



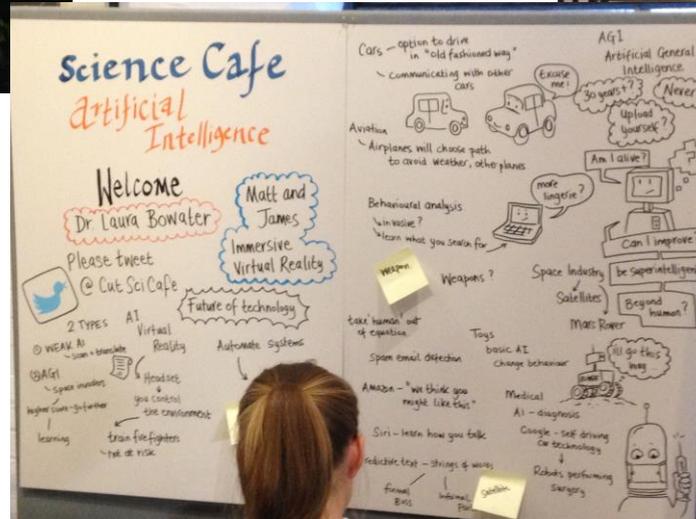
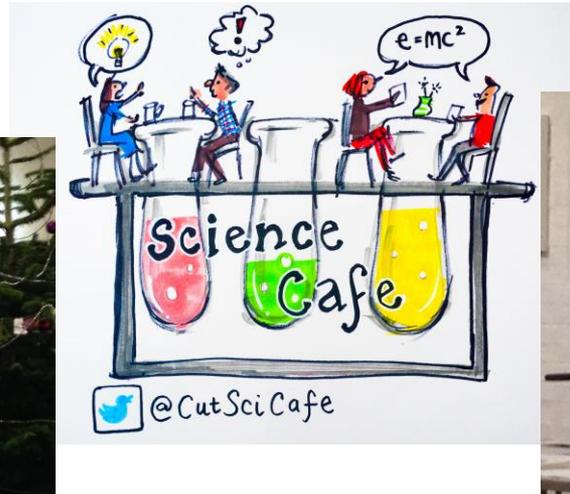
ETHICS OF PUBLIC CONSULTATION

Halesworth, Suffolk, UK

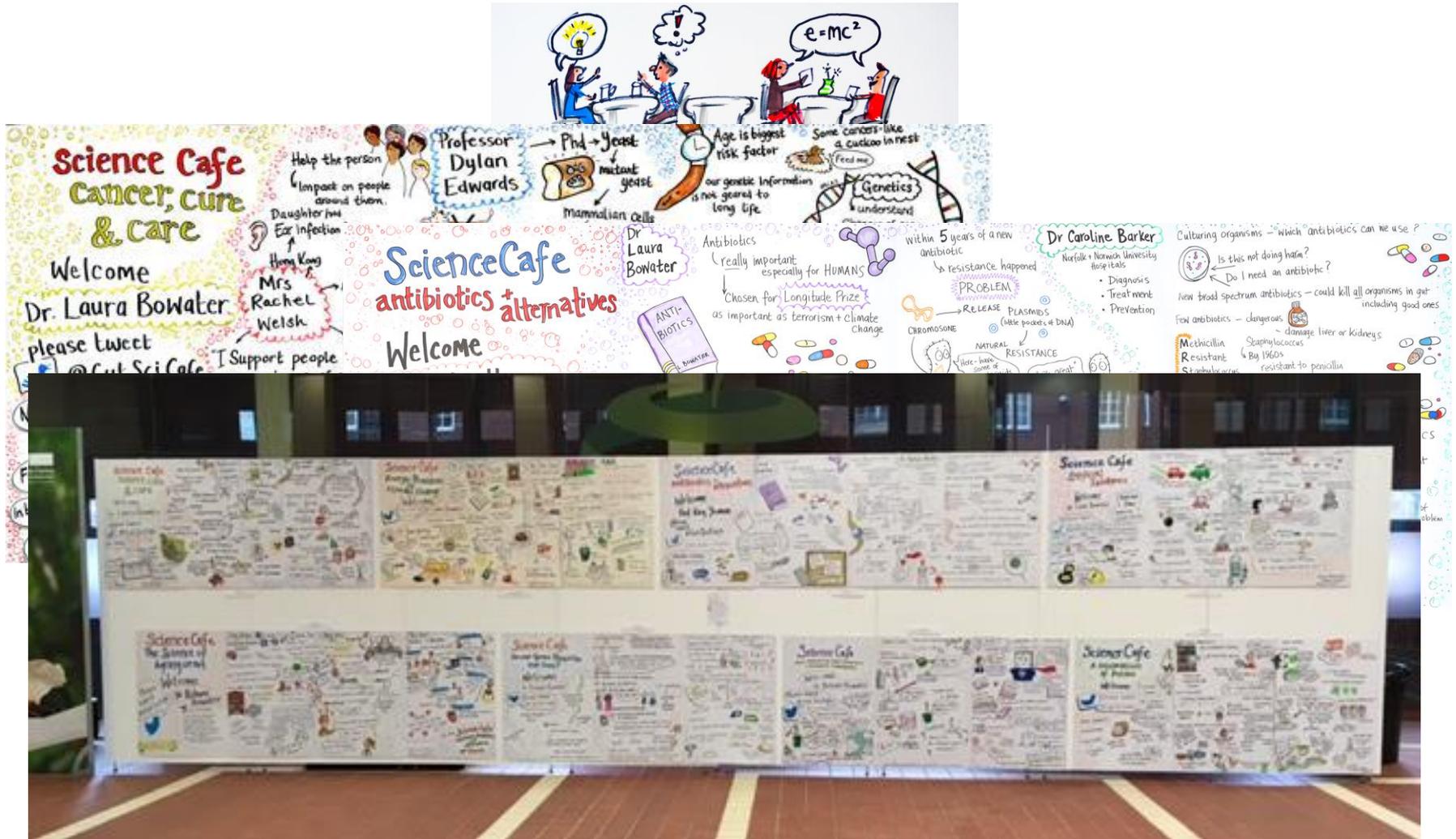
- ✧ Halesworth is a market town in north east Suffolk
- ✧ Steeped in the history of brewing, malting and agriculture
- ✧ It is home to The Cut Arts Centre - performing arts in a converted Maltings



The Cut Science Café



The Cut Science Café

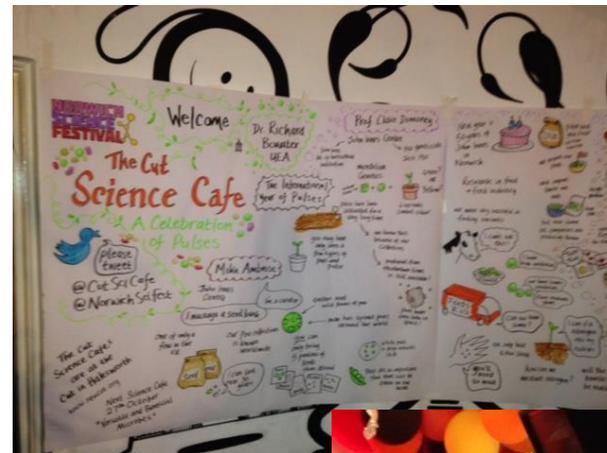


Different Types of Science Cafés

- *Pint of Science, Norwich 2016*



- *Norwich Science Festival 2016*



Norwich Science Festival 2016

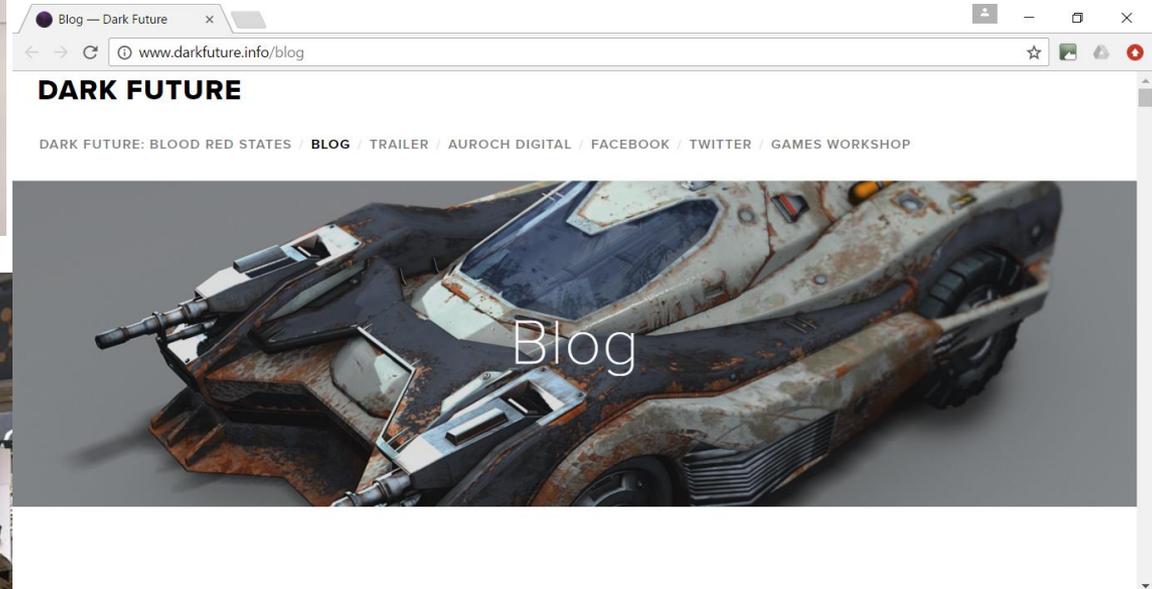
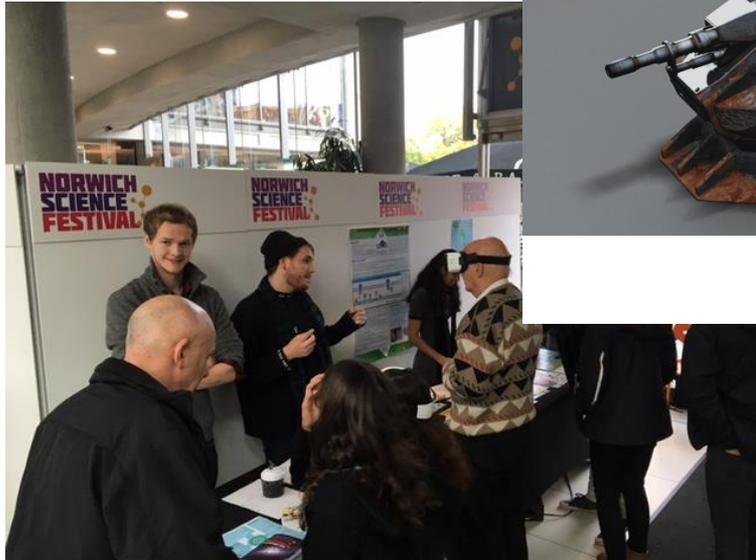


• *Norwich Science Festival 2016*



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

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