

## Virtual Lab: online experiments for schools



### What is Virtual lab?

Virtual lab is an exciting and innovative way of allowing students to engage with contemporary medical research. It is unique in that it offers students the opportunity to take part in a real-life research experiment, providing access to authentic data.

The aim of Virtual lab is to motivate, enthuse and inform young people about science and How Science Works. It provides a means of exploring how experiments are conducted and highlights the ambiguities and uncertainties in real research.

### Who is Virtual Lab for?

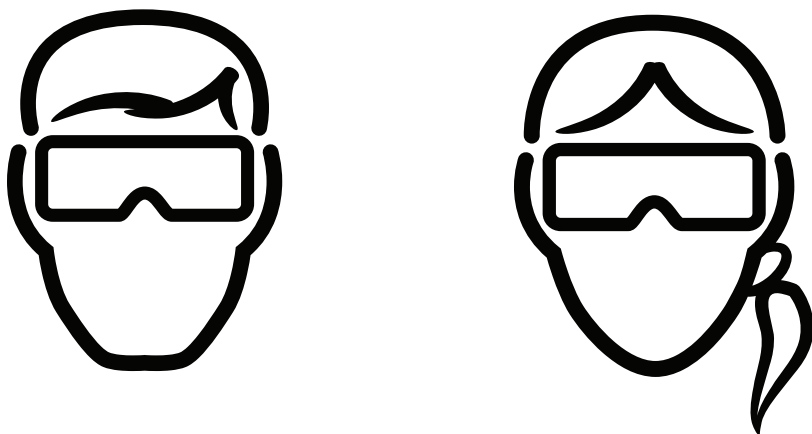
Virtual Lab is aimed at school students between the ages of 14-19. Each experiment is presented in 2 versions to support either GCSE or post-16 students.

### How does Virtual lab work?

Virtual Lab is an interactive web-based activity. The website infrastructure is in 3 parts:

- **Back-story to the research**
- **Training phase**
- **The experiment**

Students are invited to feedback regarding the project and they receive a certificate to mark their experimental success. In addition, they may be featured on a high-score board and their articles and feedback are archived in a Virtual scrapbook.



### How does the Virtual Lab website work?

Participation in a VL experiment requires registration through [www.virtuallab.co.uk](http://www.virtuallab.co.uk). Users simply choose a username and password and fill in some preliminary information regarding school, age, gender, etc. An email address is required as part of the registration but this information is treated as confidential and users can decline an invitation to receive Virtual Lab news.

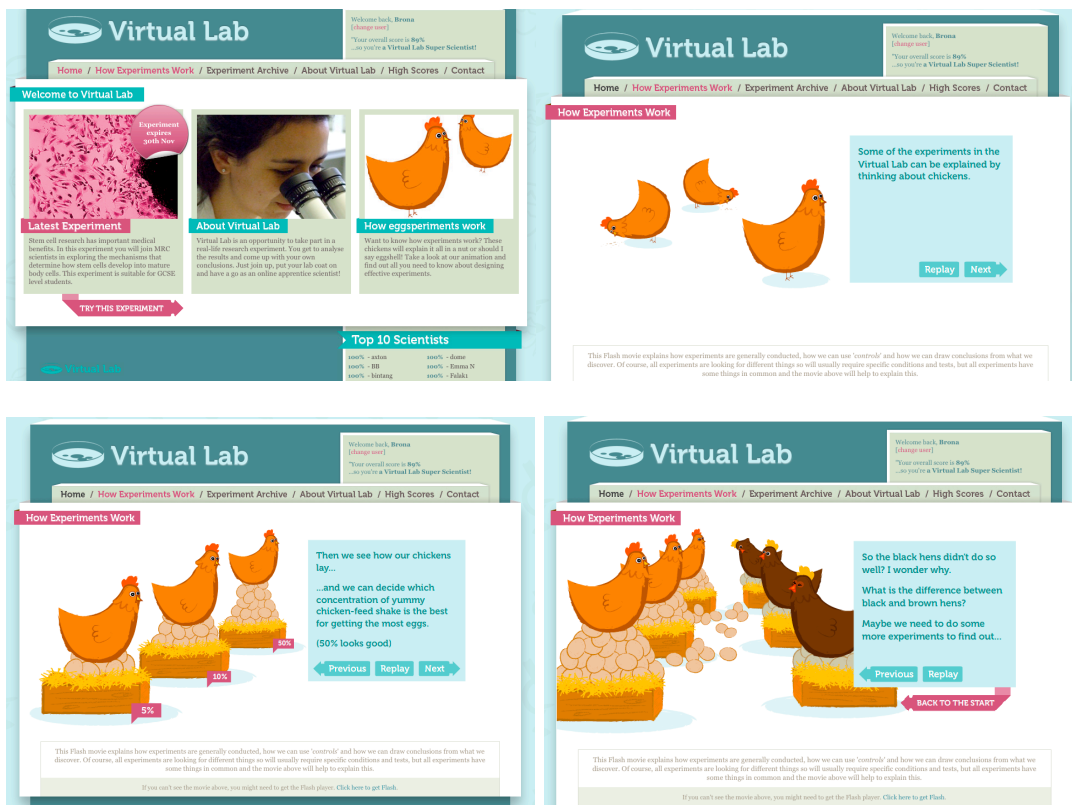
All visitors to the website can navigate throughout the site using the menu bar along the top of the page. Unregistered users can:

- Read about the project on the **About Virtual Lab** page
- Preview the chicken animation by clicking on **How Experiments Work**, which introduces pupils in a light-hearted fashion to the principles of experimental design
- Explore the scrapbooks of past experiments through the **Experiment Archive**
- Access the high-score board through **High Scores**
- Send a message to the VL administrators through the **Contact** page

Once users have registered they can log in (top right on homepage). This allows them to try the current experiment. There are 2 experiments available, one aimed at GCSE (KS4) students and another aimed at A – Level (post 16) students. The experiment is the same but the explanation and questions are differentiated to supporting learning at either a GCSE or an advanced level.

- **Background:** a series of slides to introduce students to the topic and primes them for the apprenticeship stage and the main experiment.
- **Initial scoring:** the apprenticeship phase is designed to train users to score visual data. A series of slides is presented with questions. This section may be repeated.

- **Summary question:** prompts students to address the point of the experiment and checks understanding.
- **Feedback:** apprentices are awarded a certificate. The certificate may be printed immediately or later via an automatic email to the student<sup>1</sup>.
- **Final analysis:** users compare test to control slides and log differences. A unique series of 6 slides is presented to each user.
- **Summary question:** prompts students to think about the broad question of the stem cell experiment and how experiments generally:
  - Don't necessarily provide a conclusive answer
  - Raise questions that usually require further experiments to address
- **Final question:** gives students the opportunity to write about the broader context of research, the medical, social and cultural importance of research. Well-written paragraphs in the experiment scrapbook may feature in the experiment scrapbook.



Top Left: VL homepage; Top right: VL animation – explaining experimental design using chickens; Bottom left: VL animation – what concentration of chicken feed gives optimum laying capacity? Bottom right: VL animation – comparing egg-laying capacity of wild-type versus variant chickens.

<sup>1</sup> Once the whole experiment has been completed.

### **What's the current experiment about?**

The current experiment – **Very Special Cells** – is all about stem cells. The backstory to the experiment provides information on what stem cells are, why scientists study them and their potential for providing treatments for human disease.

The experiment itself investigates a gene involved in controlling stem cell properties called *Ezh2* (a gene found in mice and humans). Students investigate the phenotype of mouse stem cells that have had the *Ezh2* gene removed (knockout cells). In the initial scoring phase of the experiment students first optimise the growing conditions of their test cells by deciding which concentration of the growth factor LIF (Leukaemia Inhibitory Factor) produces the best growth conditions. They receive a score for this activity based on their interpretation of the culture images. This activity allows students to familiarise themselves with the appearance of differentiating cells which is important for the main experiment. Students sometimes struggle to interpret the microscope images and downloadable images are available from the CSC website that can be used for close up examination and explanation of the cells.

For their main experiment they are asked to compare cell cultures of wild type/control stem cells with those of the *Ezh2* knockout cells and decide if the cells are starting to differentiate and become specialised cells? To complete the experiment they need to decide what the experiment tells us. What is the likely role of *Ezh2*? Do they think the experiment shows that *Ezh2* prevents or encourages stem cells from differentiating? Or is the result not clear? The final question gives students an opportunity to consider the broader context of stem cell biology by asking them to consider the problems associated with using embryonic stem cells.

Any interesting or insightful comments or answers may be copied into the experiment scrapbook online, once the experiment has been completed.

### **What resources are available to support Virtual Lab?**

Downloadable resources are available to support the delivery of the web-based experiment in schools, For "*Very Special Cells*" these are:

1. A **lesson plan** for both GCSE and post 16 classes.
2. **How "Eggsperiments" work** a fun online activity to demystify how experiments work.
3. A Powerpoint **presentation** giving an explanation of the different types and sources of stem cells and their applications in medicine, an explanation of the experiment.
4. A **video** presenting an interview with a stem cell scientist (this available online).
5. The **Stem Cell Grid**: a paper-based activity to check student's knowledge and understanding about different types of stem cells.

6. **Stem Cells in the News:** a fun plenary activity introducing students to how science is reported in the news.
7. **Stem cell image:** to allow close up investigation of what differentiating and non-differentiating cells look like.

### **Virtual Lab Activities**

In addition to the online experiment Virtual Lab offers a number of activities to support and enrich How Science Works and students' understanding of stem cell biology.

1. *The workshop/lesson plan*

This plan provides details of how a Virtual Lab lesson could be structured, with timings for each activity and workshop learning objectives.

2. *How "Eggsperiments" work*

A major objective of the Virtual Lab project is to demystify science. The website contains an animation designed to explore experimental design in a fun and engaging way using chickens. The idea is to convey the message that the scientific approach is a means of problem solving and can be used to investigate anything.

Guidance for using the animation:

- Give a brief introduction to science being a means of problem solving.
- Allow students to follow the animation and then discuss it in small groups (what is being investigated and how).
- Ask the students questions to explore their understanding of the experiment. Such as...  
"How did the investigator go about investigating egg-laying?"  
"Does this experiment tell us why the black hens didn't produce as many eggs?"
- Discuss problems with the experimental design, how could it be improved and what further experiments could be carried out? For instance, you could initiate discussion around the limited range of the chicken feed concentration used in the experiment. Should a concentration of greater than 50% be tried? Also students could consider the potential issues caused by only testing one chicken for each concentration.

3. *The workshop presentation*

The presentation gives information about stem cells and their uses, provides background information and a guide to the online experiment and supports all the Virtual Lab classroom activities.

#### 4. *Modelling of nuclear transfer using eggs*

This activity provides a fun way of explaining an aspect of cloning – nuclear transfer.

##### **Equipment needed**

Petri dishes

20-30 ml plastic syringes (provided in VL Ambassador Toolkit)

2 eggs

Paper towels

Gloves

Dish to collect discarded yolk

You will need to explain how embryos produced by cloning can be a source of stems and this provides a solution to the rejection of stem cell transplants. The presentation contains slides that explain this concept.

The mechanism of cloning can be brought alive using a demonstration with eggs. Two raw eggs represent:

- the recipient egg cell from a donor
- and the cell to be cloned

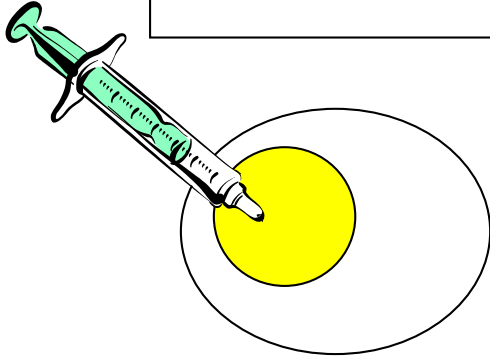
The white of the egg represents the cytoplasm and the yolk the nucleus. Ask a volunteer to come up to the front and have a go at nuclear transfer. They need to use the syringe to...

- Remove the “nucleus” from the donor egg cell and discard it
- Then transfer the “nucleus” from the cell to be cloned to its new host.

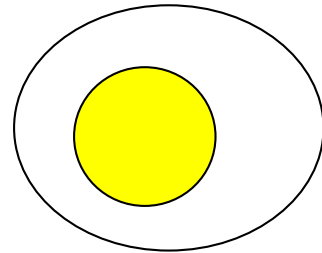
This provides a fun and active means of explaining an aspect of cloning and breaks up the explanation of the science of stem cells.

## Cloning and nuclear transfer demonstration

**Egg 1: Recipient egg**

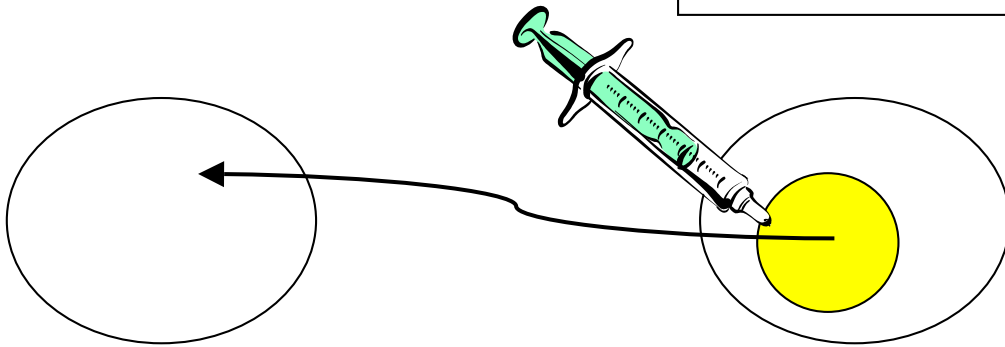


**Egg 2: Donor egg**



Remove yolk/nucleus from the recipient egg using the syringe

Replace the yolk/nucleus of the "enucleated" egg with the donor yolk/nucleus



## 5. *Video interview*

The video provides a short interview of a Dr Cynthia Fisher a stem cell scientist. It explores her motivation for choosing science as a career, her experience of working in research and what it's like to be a scientist.

## 6. *The Stem Cell Grid*

This activity is designed to check students' understanding of the different characteristics of stem cells. Working in groups of 4-5 they are given a grid with a series of statements on the left. Students are also given stem cell cards for each of the following types of stem cell.

- Embryonic stem cells from donated embryos
- Embryonic stem cells from an embryo created by cloning
- Adult/tissue stem cells from cord blood
- Adult/tissue stem cells from bone marrow

Their task is to consider each statement for each type of stem cell and place the card in a position on the grid depending on whether they agree, disagree or aren't sure.

When using with older students the activity could be used to support an examination of the ethics of stem cells. For instance they could look at the statements from the perspectives of different interest groups such as a pro-life organisation, a research scientist developing a treatment for Alzheimer's disease or a person with a spinal injury. How might they respond to this activity? Would their standpoint affect their responses?

## 7. *Stem Cells in the News*

This is an activity to use to round off the workshop. Students are given a list of news headlines about stem cells. They need to decide which headlines are real and which are fictional. Give them 2-3 mins to do this on their own and then ask the class to say which headlines they think are the fictional ones. They are in fact all real (All from the Daily Mail apart from the last which is from the Express).

This activity provides a lighthearted approach to exploring how science is sometimes presented in the news, which can be used to discuss the reasons for this and its potential impact.