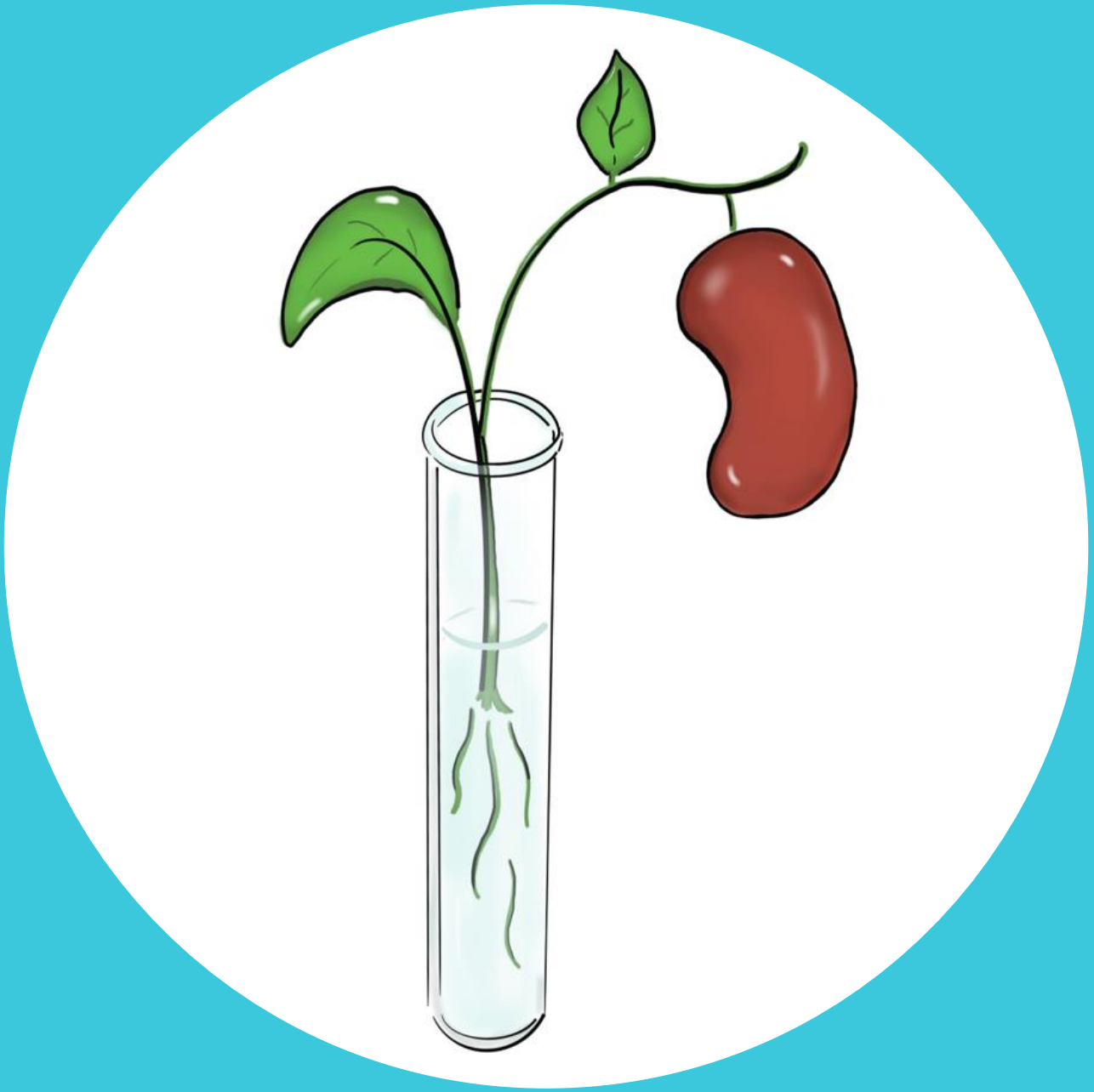
Researchers in Schools



Lab grown kidneys: Science fiction or science fact?

Key Stage 4 Programme

Pupil Name

Coursebook Designed by Dr Farmer

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Uni Pathways launch event

Welcome to Uni Pathways! We are delighted to be able to launch the Uni Pathways programme with you. We hope that you are ready to embark on your Uni Pathways journey and that you enjoy the video.
You will be asked to pause the video at times to complete some work in this workbook, so make sure you have a pen / pencil to hand when you start the video.

By the end of the video, you will have:

- Learnt about what studying at university means
- Learnt about some of the skills that you will develop during Uni Pathways
- Heard from pupils who have participated in Uni Pathways or The Scholars Programme (which is the same programme!)
- Heard from current university students talking about what life is like at university

If you are in school your teacher will play the video. If you are at home and logged in to a session with your teacher, your teacher will play the video and show it to you. If you are participating independently your teacher will email you the link to the video or the video file. There are opportunities for you to answer some questions, and you will be told when to pause the video to answer them.

Introduction to Uni Pathways

1. Write down what you think a supra-activity is.

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2. Independent learning is

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3. Write down in your own words what resilience means, and come up with a different example to the one mentioned in the PowerPoint.

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4. Why do you think analysis and evaluation skills are useful in your academic career?

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5. Why do you think analysis and evaluation skills are useful in life in general?

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6. What are the different types of learning that university students do?

Pupils' experience of Uni Pathways

You will now watch some pupils talk about their experience of learning a PhD topic and producing a final assignment. Some may refer to The Scholars Programme rather than Uni Pathways. As you heard in the introduction PowerPoint, The Scholars Programme is a very similar programme to Uni Pathways. Listen carefully and then respond to the questions below. Be prepared to share some of your responses with your peers.

1. How did the pupils describe talking about writing a long essay for their final assignment?

2. Write down something that one of the pupils mentioned was particularly interesting in their course.

3. What were some challenges that the pupils met?

Virtual campus tours

You will now go on a virtual tour of some universities! Once you have seen some of the university campuses, respond to the questions below.

1.Note down something that you liked out of any of the campus tours you saw. It may be a particular building, space, city etc.

2. Were there any similarities between the different university campuses? If so, what are the similarities?

3. If you had to pick one of those universities to go and visit in person, which one would it be and why?

4. Note down some of the societies that you could join at different universities

Meet university students!

You are about to virtually meet or hear from some current university students.
If you are virtually meeting them, think about what questions you would like to ask the students, share your questions with a partner and note those questions down in the space below.

If you are not meeting them but watching some videos that they have made, use the space below to note down what else you would like to find out about university. You can then ask your teacher during Uni Pathways tutorials!

Reflection

Congratulations on completing the launch of the Uni Pathways programme. Before you go, take some time to reflect on what you have learnt by answering the following questions:

1. Are there any aspects of university style learning that you would look forward to? If so, what are they?

2. What challenges do you think students face when learning at university? How would you try to overcome these challenges?

3. What skills do you hope to develop during your Uni Pathways course?

4. What part of Uni Pathways seems the most challenging for you?

5. What are you most looking forward to about Uni Pathways?

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			
7 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Baseline Assignment	
Tutorial 2	Pros and cons of *in vitro* and *in vivo* research	
Tutorial 3	Kidney failure leaflet for patients	
Tutorial 4	Research into the ethics of lab-grown kidneys	
Tutorial 5	Final assignment	

Assignment Submission – Lateness and Plagiarism

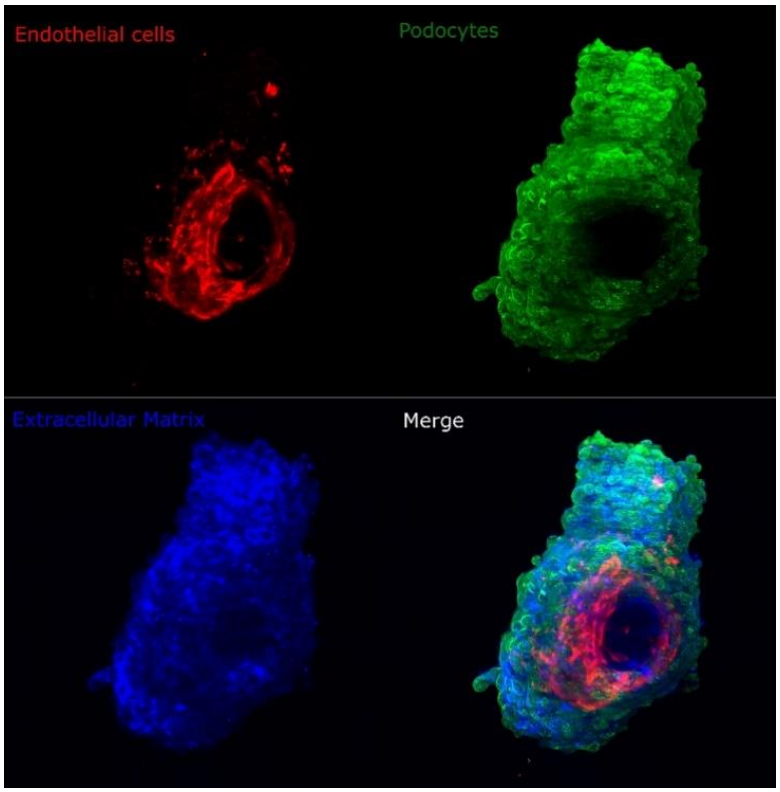
Lateness	
Submission after midnight on 9th August	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Course Rationale

If a part broke in my car I would need a replacement. But what if the mechanic couldn't find a part that fit my car's make and model? The manufacturer might have to make me a completely new part to replace it to keep my car working. Sometimes humans need replacement parts too, but these might not be readily available. What if scientists could custom make organs for patients who needed them, rather than relying on a suitable kidney being available?

Replacement kidneys currently come from human donors, but there just aren't enough to go round. There are around 6000 people in the UK waiting for a kidney transplant and the average wait to receive one is 2 - 3 years. This is because, much like car parts, a patient can't just receive any kidney, it must be a good genetic match (you wouldn't put tractor wheels on a Renault Clio and expect it to work properly). We discuss here whether it would be possible and ethical to instead grow human kidneys in laboratories so that every patient that needed a kidney could have one.

This course will teach you how we can grow cells, tissues and organs in laboratories and the practical constraints and ethical issues with doing so. You will learn how cells talk to each other, how they function, and why your kidneys are so important. We will cover the difference between *in vitro* and *in vivo* research and the advantages and disadvantages of both. It will be taught in the same style as University tutorials and there will be opportunities to debate the good and the bad of scientific research. At the end you will be putting together all the information that you have learnt and writing a final assignment arguing whether or not you think that we as scientists could and should grow kidneys and other organs in our laboratories.



Uni Pathways Mark Scheme 2020 – science-based assignments

	Subject Knowledge	Critical Thinking	Written Communication
1st	The work shows a depth of knowledge and understanding of key concepts and scientific methods, through engaging with relevant sources. Knowledge is used to build and support highly effective scientific arguments and explanations.	Analyses key scientific evidence, arguments, and reasoning. Interprets meaning and makes connections. Identifies and critically evaluates key scientific arguments and evidence, deciding on their credibility, strength, and relative significance, drawing convincing conclusions.	The work has a coherent flow and is well structured. The writing style is appropriate; scientific language and key scientific terms are used accurately and effectively to support the arguments and explanations made. There are no, or very few, errors in spelling or grammar. Consistent referencing, appropriate paragraphing and use of correctly labelled tables and graphs matching the style taught in the course.
2:1	The work shows an understanding of key concepts and scientific methods, drawing on relevant sources. Knowledge is used to build and support effective scientific arguments and explanations.	Analyses relevant scientific evidence, arguments, and reasoning. Identifies and critically evaluates relevant scientific arguments and evidence, deciding on their credibility and strength, drawing reasonable conclusions. Shows some understanding of the relative value of evidence and arguments.	The work is well-structured. The writing style is appropriate; scientific language and key terms are used correctly. There are few errors in spelling or grammar. Mostly consistent referencing and use of tables and figures; matching the style taught in the course.
2:2	The work shows an understanding of key concepts and scientific methods, with no major misconceptions. Beginning to apply this knowledge to build and support effective scientific arguments and explanations.	Identifies and uses basic scientific evidence, arguments, and reasoning. Showing some understanding of the quality of scientific arguments and evidence. Not yet showing understanding of the relative value of evidence and arguments.	The work has some structure. The writing style can sometimes be informal; occasionally scientific language and key terms are not used when it would be appropriate to do so. There are some errors in grammar and spelling do not get in the way of communicating the content. Referencing has some consistency; matching the style taught in the course Limited use of tables and graphs.
3rd	Shows a developing understanding of key concepts	Beginning to analyse scientific evidence, arguments, and reasoning.	The grammar, spelling, style, and structure of the work need

	and scientific methods, with some misconceptions. Does not yet apply this knowledge to build and support scientific arguments and explanations.	Describes evidence and arguments, while not yet evaluating them.	improving in order to communicate ideas to the reader. Scientific language, key terms and references are not always used correctly. Limited, or no use of tables and graphs.

Baseline Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Final Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

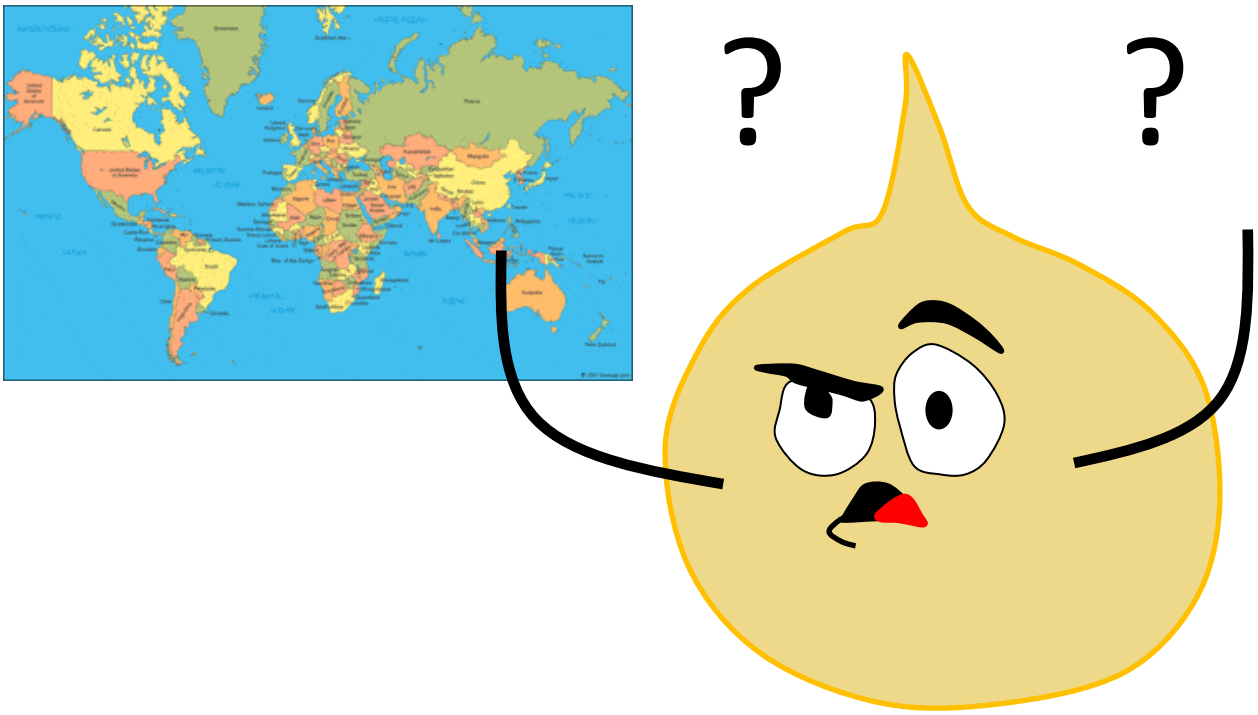
Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Subject Vocabulary

Word	Definition	In a sentence
Cell culture	The process of growing cells in a laboratory and keeping them alive and healthy.	
Podocyte	A cell with a unique function that is found in the kidney. It is specialised to make a sieve-like filter.	
Chemical Transmitter	A messenger released by a cell in the form of a chemical. It travels to nearby cells and communicates with them.	
In vitro	Research done in a dish or a test tube, not in the body. Literally translates as 'in glass.	
In vivo	Research done in a living organism, for example a mouse. Literally translates as 'in the living.	
Rejection (of an organ)	When a donated organ does not work in the person who has received it because it is not a genetic match.	
Organ deficit	The difference between the number of people who need a new organ and the amount of organs available. There are fewer organs than there are people who need them.	
Organoid	A mini organ grown in a laboratory. It contains the correct cell types for the organ, but does not have blood flow or nerve supply.	
Innervated	When an organ is supplied with nerves so that the brain can send direct messages to the organ.	
Vascularised	When an organ is supplied with blood vessels so that it can receive oxygen and waste products can be taken away.	

Tutorial 1 – Where does wee come from?



What is the Purpose of Tutorial 1?

This tutorial will make you think about all the different types of cells that are needed to make an organ work, and how they are specialised to their unique functions.
We will learn about the kidney, your fabulous wee-filtering organ, and it's special octopus-shaped cell called the podocyte.

By the end of this tutorial you should be able to:

- Explain why cells specialise
- Describe the role of the kidney
- Use the podocyte as an example of a specialised cell

Activity 1 Building a human

"Concrete Housing Construction in Chile" by Concrete Forms is licensed under CC BY 2.0

Imagine that you are building a house, would you want all your building blocks to look the same, or would you need different parts? Why or why not? Discuss with your partner and write your answer in the space below.

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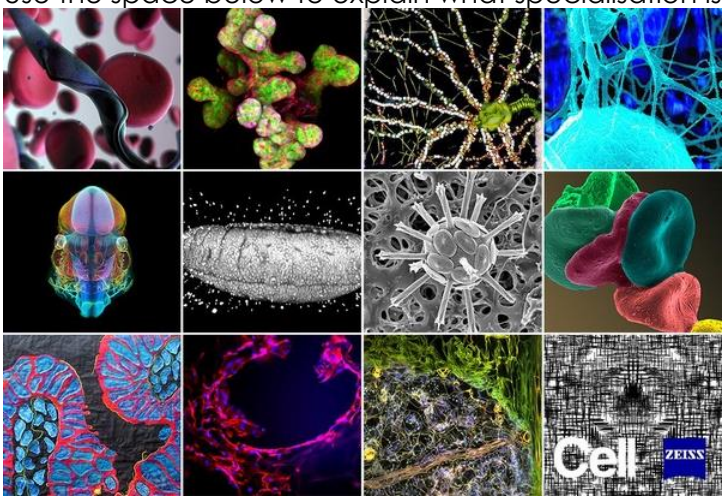
Cells are the building blocks of the body and different cell types specialise in different ways. Use the space below to explain what specialisation is and why cells do it.



"2013 Best of Cell Picture Show" by ZEISS Microscopy is licensed under CC BY-SA 2.0

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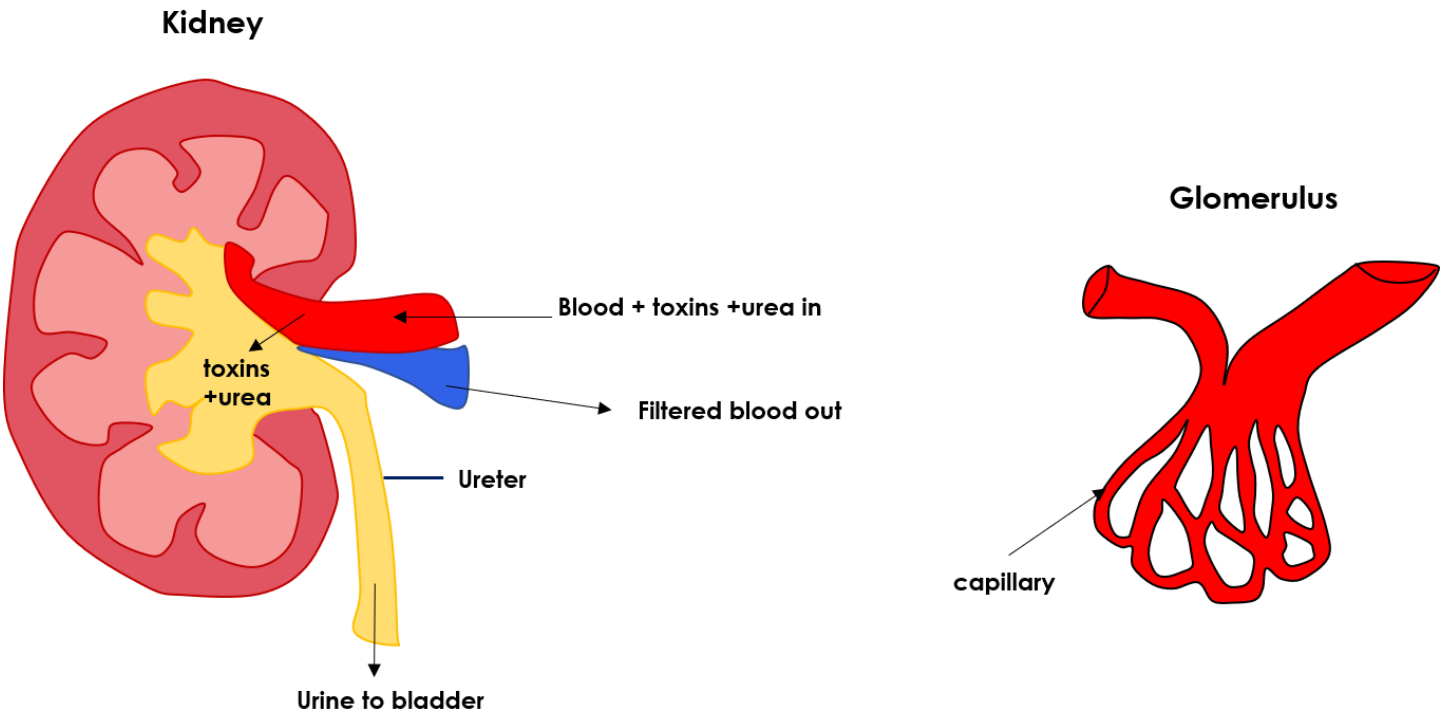
Activity 2 From cells, to tissues, to organs

Watch the video and then fill in the table. One answer has been filled in as an example
https://www.youtube.com/watch?v=VO2QkpwAG9o

Definition	Word	Example
Made of a group of different tissues which all work together		
Made of a group of cells with a similar structure and function		
The unit of life	Cell	Red blood cell
An individual life form		
A group of organs		

Activity 3 To wee or not to wee….



Fill in the blanks:

The kidney is an..... You have.....kidneys located in your lower

They have three main roles:

1. Removal of.....and.....from the blood as they are
2. Adjustment of.....levels in the blood
3. Adjustment of.....content of the blood

They do this by.....the blood at high..... The blood vessels branch off to increase the..... ..... The filtering takes place in a structure called a ..... They..... the things you need, for example and they produce.....from the waste.

Introducing the podocyte….

NCMIR Kidney glomeruli Mark Ellisman and Tom Deerinck, National Center for Microscopy and Imaging Research

Draw and label a podocyte in the space below. Write how it is specialised for its role.

Homework – baseline assignment

Write 300 words explaining what the kidney does and how the podocyte is specialised to help it do this.

Be sure to:
- Introduce your work
- Describe what the kidney does
- Explain that it needs specialised cells to do this
- Describe a podocyte including what it does and how it is specialised to do that
- Conclude your work

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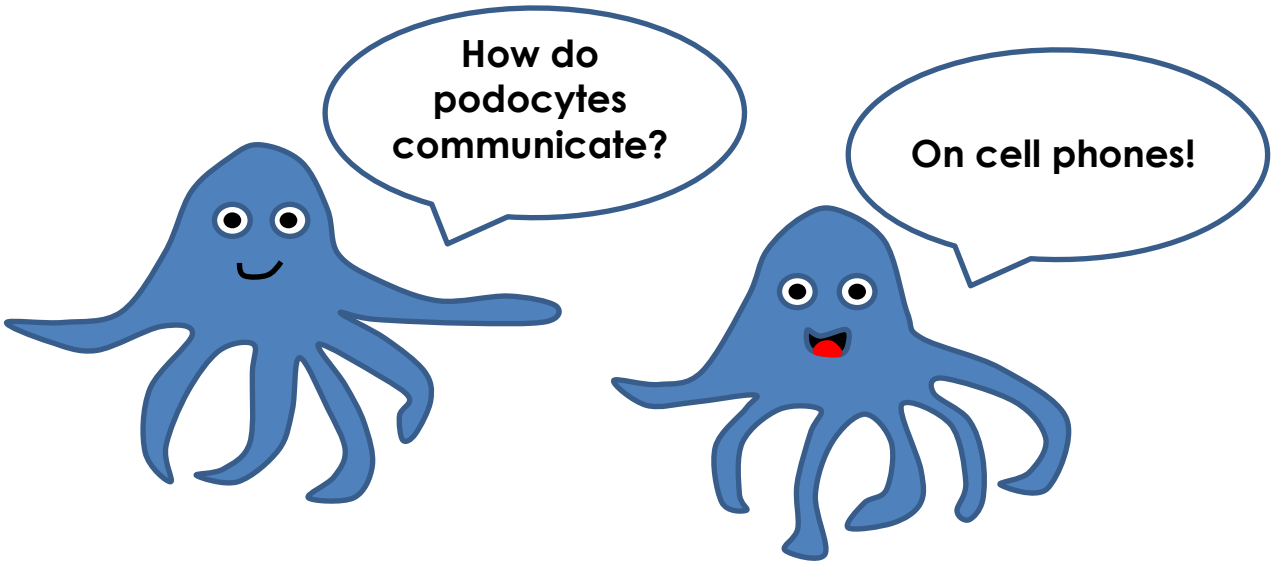
Tutorial 2 – Do cells have conversations?



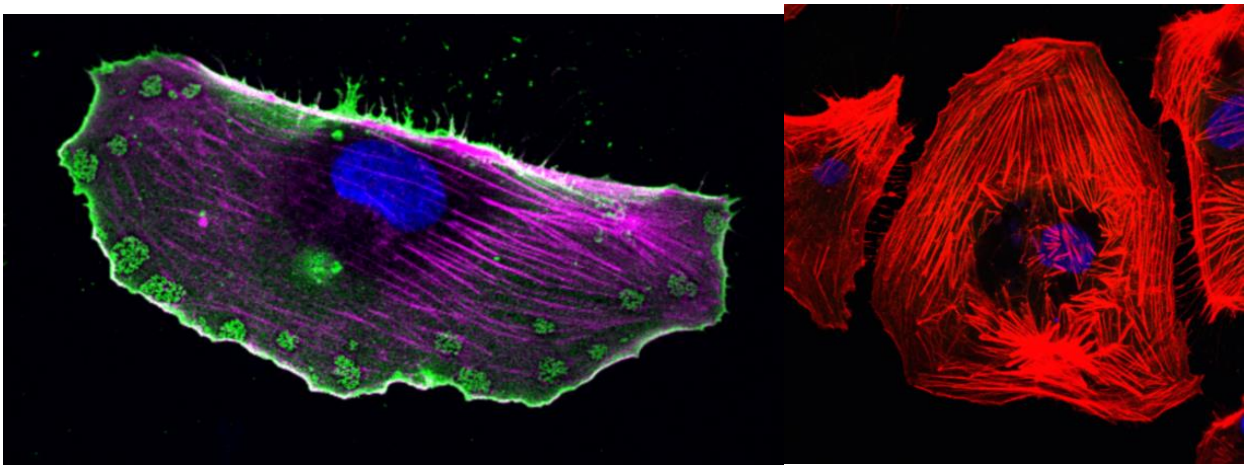
What is the Purpose of Tutorial 2?

This tutorial will teach you that communication between cells is vital for normal bodily function. We will discuss how a lack of this cell communication can be a problem for scientists when they want to do research in the laboratory and why animal research may or may not be a better alternative.

By the end of this tutorial you should be able to:

- Understand that cells communicate with each other
- Define *in vivo* and *in vitro* research
- Compare the advantages and disadvantages of these research techniques

Activity 1 Cell chit chat



Images of cells taken by Dr L K Farmer

Use the space below to explain the two types of communication used by cells in your own words.

Physical:

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Chemical:

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Activity 2 vitro or vivo?

Put a cross in the box to indicate whether each example is an example of *in vivo* or *in vitro* research

Research	Vitro	Vivo
Adding ethanol to liver cells		
Timing how long it takes for a mouse to get out of a maze		
Testing an anti-cancer drug in a monkey		
Extracting DNA from human saliva		
Using a microscope to observe red blood cells		

Activity 3 This house believes…

Discuss with your partner the pros and cons of in vitro and in vivo research. Use the prompt questions below and the starter statements on the board to help you.

- Which is cheaper?
- Which is more realistic?
- Which might have ethical concerns?
- Which is easier to repeat?

We will have a mini debate after this activity where we will argue whether in vitro or in vivo is better, you will be assigned a side to argue.
Use this space to take notes:

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Homework

Write **300 words** on the pros and cons of *in vitro* and *in vivo* research. Be sure to introduce what each research type is before stating their advantages and disadvantages.

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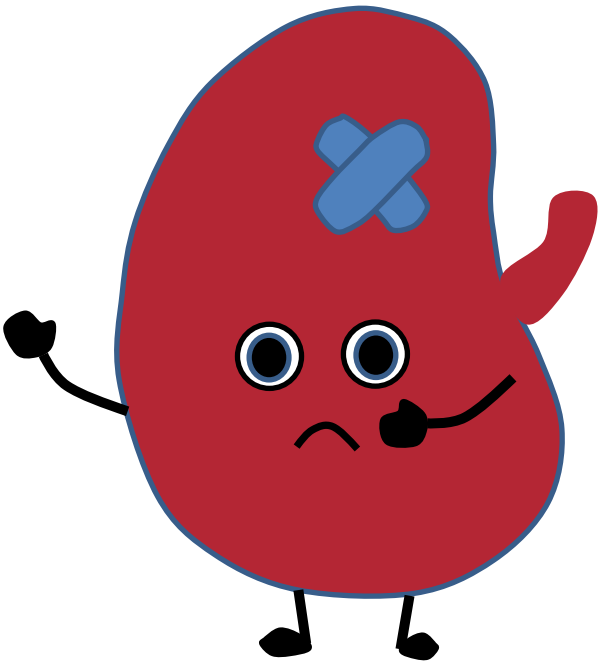
Tutorial 3 – When kidneys get sick



What is the Purpose of Tutorial 3?

In this tutorial we will think about what happens to a person if their kidneys stop working. We will think about the physical and emotional impact on their lives and the impact it has on society too. We will discuss the current treatment options available for patients and learn about organ rejection and how it can cause kidney transplants to fail.

By the end of this tutorial you should be able to

- Explain what happens when a kidney fails
- Describe the treatment options currently available
- Understand why organ rejection is an issue

Activity 1 Failure is an option

In the first tutorial we learnt what the kidney does. Use the box below to describe the functions of the kidney in your own words.

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Now fill in this table linking the symptoms of kidney failure to the kidney's function, based on the class discussion.

Symptom	Function it is linked to

Activity 2 The doctor will see you now

"Surgery Image 2" by UCDMedicine is licensed under CC BY-NC-ND 2.0
Dialysis image kindly provided by Maddy Warren.

Use the space below to take notes on the treatments available to patients based on the presentation

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Read the following resources:

Cost-effectiveness of transplantation

• Kidney transplantation is highly cost-effective, particularly in relation to NHS spend, and is the treatment of choice for many patients with end-stage renal failure.

• The indicative cost of maintaining a patient with end-stage renal failure on renal replacement therapy (dialysis) is £17,500 per patient per year for a patient on peritoneal dialysis and £35,000 per patient per year for a patient on hospital haemodialysis.

• There are over 37,800 patients with end-stage renal failure in the UK. Nearly 21,000 are on dialysis, whilst the remainder have a transplant. Of those on dialysis, 76% are on haemodialysis and 24% on peritoneal dialysis.

• The average cost of dialysis is £30,800 per patient per year.

• 3% of the NHS budget is spent on kidney failure services.

• The indicative cost of a kidney transplant (including induction therapy but excluding NHSBT costs) is £17,000 per patient per transplant.

• The immuno-suppression required by a patient with a transplant costs £5,000 per patient per year.

• Kidney transplantation leads to a cost benefit in the second and subsequent years of £25,800 pa.

• The cost benefit of kidney transplantation compared to dialysis over a period of ten years (the median transplant survival time) is £241,000 or £24,100 per year for each year that the patient has a functioning transplanted kidney.

• In 2008-09, 2,497 people received a kidney transplant. These transplants are now saving the NHS £50.3m in dialysis costs each year for every year that the kidney functions.

• In 2008-09, 215 more kidney transplants were provided than in the previous year. These transplants are now saving the NHS £4.5m every year until graft failure.

• At the end of March 2009, the UK Transplant Registry had records of over 23,000 people in the United Kingdom with a functioning kidney transplant. In this year, these patients will save the NHS over £512m in the dialysis costs that they would need if they did not have a functioning kidney transplant.

• On 1 April 2009 there were 6,920 patients waiting for a transplant of which the majority will be on dialysis, costing around £193m per year. If all of these patients received a transplant, the approximate cost would be £41m per year, which represents a saving to the NHS of £152m per year.

https://nhsbtmediaservices.blob.core.windows.net/organ-donation-assets/pdfs/Organ_Donation_Registry_Fact_Sheet_7_21337.pdf

"It's my goal to not waste the gift of life I was given."
Katie

Katie was 27 when she had the operation which ultimately saved her life. Her donor was an anonymous stranger who decided to donate their kidney to whoever turned out to be the best match.

Katie was diagnosed with renal failure aged 19 after blood tests following back pain and nose bleeds.

"I wanted to be a paramedic so I had to change my whole life plan, " she explained. "My day to day plans revolved around dialysis."

Katie's typical day on dialysis would involve four fluid exchanges starting at 6.30am, and sometimes finishing as late at 1am, with a day's work in the middle.

"I didn't want any pity or special treatment, I remained defiant that I didn't need a transplant for years. I didn't want to lose that feeling of normality at work or out with friends."

"I had to clock watch every day - my day to day plans revolved around dialysis. I watched friends move on with their life. I never told anyone about my dialysis or that I had end stage renal failure until I was discharged from having the transplant - I put it as a status on Facebook."
" I never told anyone about my dialysis or that I had end stage renal failure until I was discharged from having the transplant. "

Katie said: "By the time of my transplant, I had been on dialysis for eight years. I was tired, depressed with feeling so unwell and with having no freedom. I felt dizzy and sick, and I had headaches.

"I thank my donor every day for my gift of life. It's my goal to not waste the gift of life I was given. I think it is really important to raise awareness amongst young adults, so that they have the knowledge to pass on to their relatives and children."

https://www.nhsbt.nhs.uk/how-we-help/saving-lives/patient-and-donor-stories/katies-story/

In your own words explain why the lack of available organs for transplant (the organ deficit) is a problem, including the impact that it has on both patients and society.

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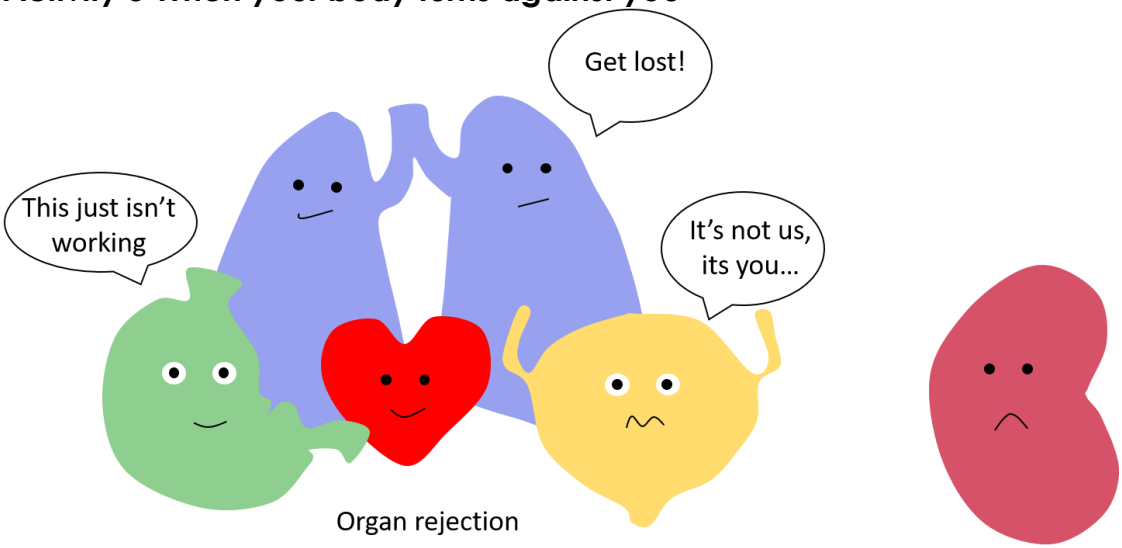
Activity 3 When your body turns against you



What happens when a foreign body such as a pathogen enters the body? How does the body respond?

When a ..... enters the body it is recognised by the.....system. The .....cells in this system recognise proteins on the.....called .....These proteins tell the host that there is a..... body present and cause it to produce ..... The.....system will then.....the pathogen.

In your own words explain why this is an issue for patients receiving a donor organ

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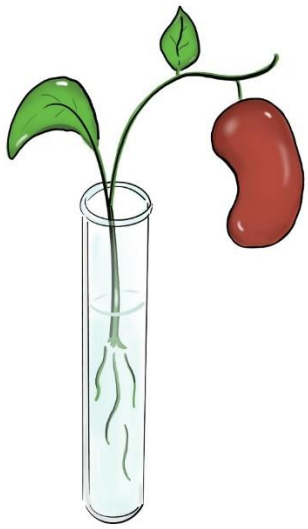
Activity 4 Are laboratory-grown kidneys the answer?



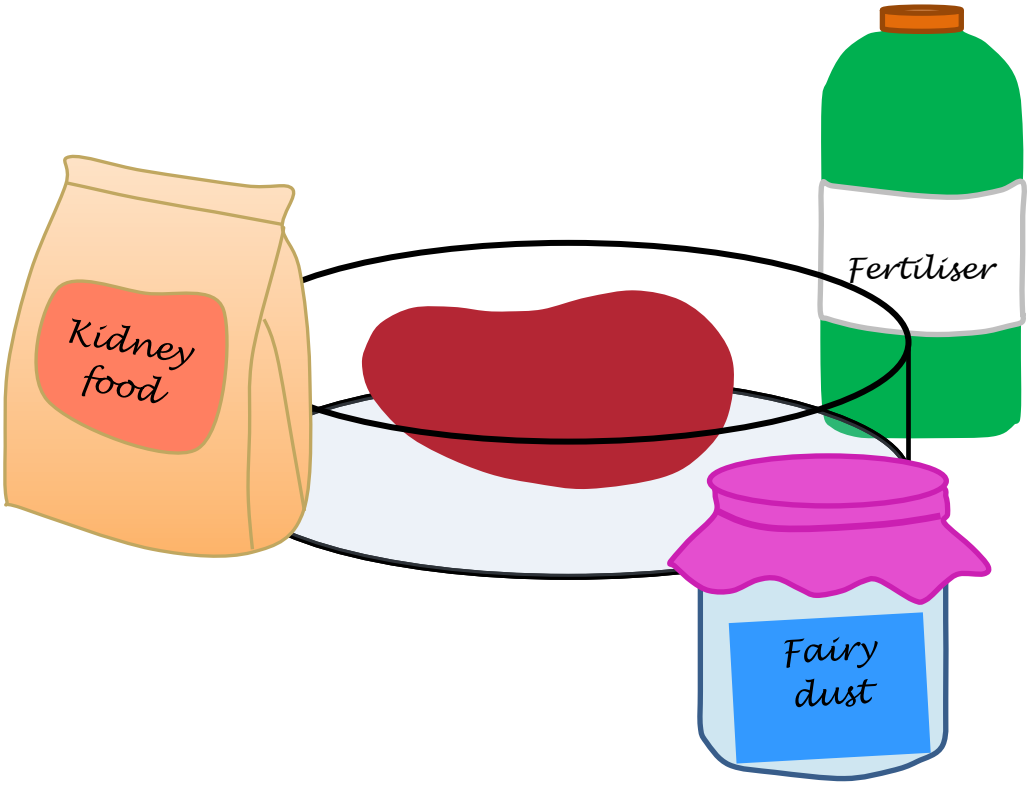
Based on what we have learnt in the first three tutorials, use the table below to list some reasons that laboratory-grown kidneys might be useful. Think about how they could help in transplants and research.

Transplant	Research

Homework

Make an A4 leaflet that could be given to a patient with kidney failure. The leaflet should first explain what kidney failure is and then focus on the treatment options available to patients. You should mention the advantages and disadvantages of each option.

Tutorial 4 – Could we grow a kidney in a laboratory?



What is the Purpose of Tutorial 4?

In this tutorial you will learn about cutting edge research that is trying to make a laboratory-grown kidney a real possibility. This is organoid research. You will also be taught how to read scientific information effectively and encouraged to think about how we decide whether or not to trust this influence.

By the end of this tutorial you should be able to:

- Describe what an organoid is
- Understand the practical issues with current organoid techniques
- Understand how to critically evaluate scientific writing

Activity 1 Growing a kidney in a dish

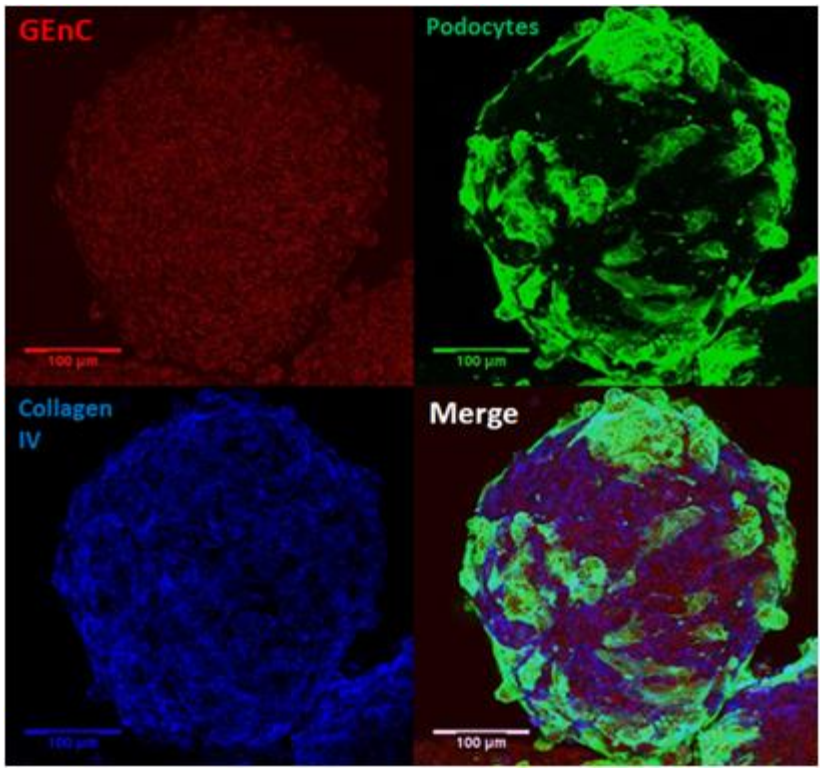


Image taken by Dr J Tuffin.

After watching the presentation write in your own words what an organoid is.

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State some advantages

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What are the disadvantages?

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Look at the table below, which of these properties do you think cell culture, organoids and animal research have?

	Cell culture	Organoid	Animal Research
Cells			
Tissues			
Blood flow			
Media			
Nerves			
Input from the brain			
Tissue cross talk			

Activity 2 Critical Reading

In order to know whether to trust something we read; we need to think about it critically. Use the space below to define critical thinking and make some bullet points on things to consider when reading scientific information.

Critical thinking is:

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Things to consider when assessing scientific content:

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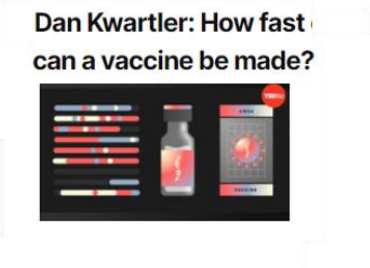
Activity 3 – Fake news

Give each of the following sources a reliability rating from 1-10. 1 Being completely unreliable and 10 being highly reliable.

Youtube video from an anti-vaccine group called 'Dirty Medicine'



Ted talk about how quickly vaccines can be made

BBC news website article

Public Facebook post from someone you don't know

Website called 'vaxtruth

Section on vaccination in GCSE biology textbook

Peer reviewed journal article

Interview with a vaccine scientist

Newspaper article

Homework

Conduct some independent research to identify three ethical concerns that people might have about growing kidneys in a laboratory.
Some questions to think about are:
How might animals be used?
How would we decide who gets these kidneys?
Could there be any financial issues?
Are there any concerns about growing human tissues?

Here are some resources to start you off (these are available in the appendix at the end of this booklet):

https://singularityhub.com/2017/01/27/the-ethics-of-organoids-scientists-weigh-in-on-new-mini-organs/

https://blogs.bmj.com/medical-ethics/2014/11/06/growing-a-kidney-inside-a-pig-using-your-own-dna-the-ethics-of-chimera-organs/

https://www.estevanmercury.ca/opinion/editorial/is-it-ethical-to-grow-human-organs-1.1445072

However, it is very important that you do your own research in addition to this and find at least two additional sources. Please write down what sources you have used at the end of your homework. These could be websites, journal articles, YouTube videos, anything that is useful to your work.

Tutorial 5 – Should we grow kidneys in the laboratory?

What is the Purpose of Tutorial 5?

In this tutorial we will make sure that you have a good understanding of ethical concerns that some people have about growing organs and organoids in laboratories. You will then be introduced to the final assignment. The tutorial will teach you how to structure a University-style essay and how to correctly reference any sources you use when writing your assignment.

By the end of this tutorial you should be able to:

- Discuss ethical concerns around growing kidneys in the laboratory
- Understand how to structure an essay
- Execute correct referencing

Activity 1 – An ethical issue

After the class discussion about last week's homework please fill in the table

Ethical Issue	Reason

Activity 2 Keep calm and cite your sources

Based on last week's discussion on source reliability, how reliable do you think the sources you used were? Give each one used a score out of 10. 1 Being completely unreliable and 10 being highly reliable

Source	Reliability score	Reason

Use the presentation about referencing to help you reference the sources that you used in your homework.

Activity 3 – Introducing the final assignment

Use the space below to make a mind map of all the knowledge you have learnt about laboratory-grown organs. This should include things such as what they are, what they can be used for, what the practical problems with them are, why we need them and why people might have ethical issues with them.

Activity 4 – Essay structure

Now use the essay structure template to turn some of the points from your mind map into an essay plan.

Introduction ~10%
Provide context/background, give an outline of your essay structure and state your argument

Body ~80%
A sequence of linked together paragraphs that explain your point.

Use the full essay question to help you plan these paragraphs

Conclusion ~10%
State your position and sum up your argument

Paragraph 1

Paragraph 2

Paragraph 3

Paragraph 4

Homework – Final assignment

You have just been appointed head of a new Government organisation – the laboratory-grown organs committee. As part of your new role the Government would like you to write a report to help them decide whether to legalise laboratory-grown kidneys for transplant and research purposes.
You should write a 2000 word (+/- 10%) report titled '**An analysis of the need for laboratory-grown kidneys and the practical and ethical concerns with generating them**'. Be sure to include the following under appropriate subheadings:

- A brief introduction to the report
- What an organ is and why kidneys are so important
- Medical and research reasons that laboratory-grown kidneys might be necessary
- Can we grow a kidney in the laboratory? What have the scientists found so far?
- Balanced arguments on the ethical issues with growing kidneys in laboratories
- Your conclusion on whether you think laboratory-grown kidneys should be legal.

Your report should include information we have covered in the tutorials as well as independent research. Include any diagrams and/or tables that help support your points and make sure to label them and discuss them in the text. Think about and discuss how reliable your resources are.

In order to achieve to the best of your ability you should show that you are able to:

- Show a depth of scientific knowledge and understanding and use that knowledge to support your arguments
- Use scientific terms appropriately
- Check your spelling and grammar
- Reference your sources as we discussed in the tutorials

It is important for you to think about whether you think laboratory-grown kidneys are a good idea **before** you start writing the report and use your opinion to help you. There is no right or wrong conclusion to make, but make sure to include arguments on **both** sides of the debate!

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on your final assignment
- To respond to the feedback from your Uni Pathways teacher
- To write targets for improvement on your final assignment

Final assignment feedback from your Uni Pathways Teacher

(Remember to look at the mark scheme to help you understand what you have done well so far, and how you can do even better in your final assignment)

Here are three things that my Uni Pathways Teacher thought I did well in my draft assignment
•   •   •

Here are three things that my Uni Pathways Teacher thinks that I could do to get a higher mark in my final assignment
•   •   •

Tasks from my Uni Pathways Teacher to do during the feedback tutorial to help me improve
•   •   •
My response:

Actions I will take to improve my final assignment after this tutorial…
•   •   •

Hand in date for my final assignment:	

Tutorial 7 – Final tutorial

What is the Purpose of Tutorial 7?

- To receive feedback and a grade on your final assignment.
- To reflect on the programme including what you enjoyed and what was challenging.
- To ask any questions you may have about university.

Final assignment feedback from my Uni Pathways Teacher

Final mark:	University style grade:
Feedback: Here are three things that my Uni Pathways teacher thought I did well in my final assignment • • •	

Here are three things that my Uni Pathways teacher thinks I should remember for when I am doing this kind of study in the future
• • •

University

What questions do you still have about University after taking part in Uni Pathways?
•   •   •

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should you use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].
2. **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

    a. **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

    E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

    b. **Books** – Author, date published, title of book (in italics), pages where the information came from.

    E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

    c. **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

    E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 2 – Ethics of Organoids Resources

Resource 1:
The Ethics of Organoids, Scientists Weigh in on New Mini-Organs
By Edd Gent Jan 27th 2017
https://singularityhub.com/2017/01/27/the-ethics-of-organoids-scientists-weigh-in-on-new-mini-organs/

Growing organs in the lab is an enduring sci-fi trope, but as stem cell technology brings it ever closer to reality, scientists are beginning to contemplate the ethics governing disembodied human tissue.

So-called organoids have now been created from gut, kidney, pancreas, liver and even brain tissue. Growing these mini-organs has been made possible by advances in stem cell technology and the development of 3D support matrices that allow cells to develop just like they would in vivo.

Unlike simple tissue cultures, they exhibit important structural and functional properties of organs, and many believe they could dramatically accelerate research into human development and disease.

For developmental biologists, these structures offer unprecedented insight into how cells self-organize to become organs. For those developing drugs, they provide a far more nuanced understanding of how the human body will react to certain compounds and could potentially reduce the need for research on animals or risky early trials on human volunteers.

Organoids grown from a patient's stem cells could be used to repair damaged organs or personalize their treatment by testing how they react to different drugs. Earlier this year, a Dutch university spin-out partnered with an insurance company to launch a €3 million trial into using organoids to determine patients' responses to new cystic fibrosis drugs.

On the face of it, it's hard to see the downsides, but a review of the field published in *Science* last week highlights that things may not be as clear-cut as they seem. For a start, the authors point out that organoids are unlikely to do away with human and animal testing.

They still fail to replicate important features of real organs, such as blood vessels, nerves and immune cells, and also can't replicate the interactions between organs that a body, animal or human would. A DARPA-funded "body-on-a-chip" could solve the latter problem by connecting organoids with a blood substitute, but the approach is still experimental.

It may make it harder to justify animal research, shifting the onus onto researchers to justify why they need to test on animals rather than organoids. And as organoids can be grown from organ-specific adult stem cells and induced pluripotent cells—adult cells that have been reprogrammed into stem cells—they could reduce the need for controversial experiments on embryonic and fetal tissue.

In the short term, though, the technology could actually lead to an increase in the use of human embryonic material, the researchers say. Currently, many organoid approaches rely on embryonic stem cells. In addition, validating organoid models will most likely require comparison to gold standard embryonic stem cell models.

If the technology takes off and is put to use for precision medicine, the lines between research and medical care may also start to blur, which may put a strain on current approaches to ethical review and have broad implications for which medicines insurance providers should cover.

Maintaining a steady supply of organoids for both medicine and research will require the creation of biobanks stocked with donated tissue, which will raise complicated challenges regarding donor consent and ownership.

It is not yet clear what patients' attitudes towards organoids grown from their tissue will be and what they will be prepared to let happen to them. The authors also point out that for many, organoids may not be a morally neutral alternative to embryos.
An editorial in Nature points out that there will be pressure to ensure these kinds of self-organizing tissues provide the best developmental model possible. But in the extreme, this drive could lead to complete human embryos engineered from pluripotent stem cells. No embryonic material was used in its creation, but is it materially different from a human embryo?
There are many shades of gray in between. Work on mini-brains has delivered organoids that spontaneously generate electrical activity, producing brain waves. You would be hard pressed to convince anyone they were thinking as we understand it, but as these technologies get more advanced, where do you draw the line?
It's hard to say exactly when a collection of cells becomes a living being and what the ethical implications are as you near this demarcation. As the author of the Neuroskeptic column in Discover puts it, "The funny thing is, doing this kind of research is probably the only way we'll ever work out whether it's ethical or not."

Resource 2
Growing a Kidney Inside a Pig Using your own DNA: The Ethics of 'Chimera Organs'
By David Shaw 6th November 2014
https://blogs.bmj.com/medical-ethics/2014/11/06/growing-a-kidney-inside-a-pig-using-your-own-dna-the-ethics-of-chimera-organs/

Imagine that you're in dire need of a new kidney. You're near the top of the waiting list, but time is running out and you might not be lucky enough to receive a new organ from a deceased or living donor. But another option is now available: scientists could take some of your skin cells, and from them derive stem cells that can then be added to a pig embryo. Once that embryo is implanted and carried to term, the resulting pig will have a kidney that is a perfect genetic match to you, and the organ can be transplanted into your body within a few months without fear of immune rejection. Would you prefer to take the risk of waiting for an organ donated by a human, which would require you to take immunosuppressant drugs for the rest of your life? Or would you rather receive a "chimera organ"?
This scenario might seem far-fetched, but it is quite likely to be a clinical reality within a decade or so. Scientists have already used the same technique to grow rat organs inside mice, and it has also been shown to work in different types of pig. Although clinical trials in humans have not yet taken place, using these techniques to create human organs inside animals could solve the current organ scarcity problem by increasing supply of organs, saving thousands of lives each year in Europe alone. As illustrated in the example, organs created in this way could be tailored to the individual patient's DNA, allowing transplantation without the risk of immune rejection. However, the prospect of growing organs of human origin within (non-human) animals raises several ethical issues, which we explore in our paper.
Although chimera organs are 'personalised' and unlikely to be rejected, one of the major concerns about using organs transplanted from animals is the risk of 'zoonosis' – the possibility that an animal virus might be transmitted along with the organ, resulting in a new disease that could cause a pandemic. Any pig used to create an organ for transplant would be kept in a very sterile environment to minimize any such risk. But even if the risk of zoonosis is extremely small, we also need to consider the magnitude of the harm that might result should the worst-case scenario be realized. A new source of organs sounds like a wonderful thing, but it's not if they go on to cause a pandemic of "pig flu" that kills thousands of people. However, there have been no documented cases of zoonosis following xenotransplantation (transplants from animals); transplanting organs that are

genetically human is likely to be safer still, provided that animals are raised in sterile environments and organ recipients are closely monitored after transplantation.
Another worry about adding human stem cells to pig embryos is that the resulting pigs might acquire human features. If a pig grew a human foot, it could be disconcerting. But what if it showed signs of human self-awareness? The risk of this happening is even lower than the risk of zoonosis, but if it did, could we still confidently draw the line between humans and animals? Luckily, there are technical ways of making sure that this is simply not a possibility. This could be done by 'knocking out' the genes for morally sensitive aspects of human development (such as brain and reproductive system) in the stem cells added to the pig embryo, so that there really was no risk at all of the pig developing these human characteristics.
But there is a more obvious ethical issue that cannot be so easily dealt with: every time a pig is used to create an organ, a pig will be sacrificed. To someone who eats meat, this might seem like a trifling objection: surely it's ok to use an animal to save a human life if we eat them every day? But defenders of animal rights will argue that the creation of chimera organs involves using animals purely as a means to the end of saving human lives, and that doing so is deeply unethical. Why should we use animals to supply humans with organs when so many people refuse to donate their organs after their death? Shouldn't we increase donations from humans rather than instrumentalising animals in this way? It's true that efforts to encourage humans to donate should certainly continue, but the truth is that we really need a new source of organs. Lab-grown organs still seem a long way off, and chimera organs also offer the advantage over normal donations that they will not be rejected by the recipient's immune system. Given the way animals are currently exploited by humans, using them to create lifesaving organs actually seems more ethical than eating them or using them for research.
A last concern relates to human dignity. Conservative commentators have long argued that it is against human dignity to mix our DNA with that of animals. We explore this objection at length in our paper; our view is that human dignity is a very fuzzy concept which can be used to argue both against and for the use of chimera organs. Is it dignified to let people suffer and die when we could use this new biotechnology to provide them with organs that will let them live long and happy lives? In the UK alone, 3 people die every day waiting for an organ, and creating organs in chimera pigs could save these lives and improve the lives of the thousands of people who must undergo dialysis every week. Ultimately, hearts and other organs could perhaps be created in this way too. While this source of organs is not entirely without risks, we believe that they are worth taking.

Resource 3:
Is it ethical to grow human organs?
By Jordan Baker & Tonaya Marr / Estevan Mercury
June 22nd 2012
https://www.estevanmercury.ca/opinion/editorial/is-it-ethical-to-grow-human-organs-1.1445072

He said

The important thing to keep in perspective when dealing with a topic like this is why we are growing an organ.

In cases where we are dealing with people who have some kind of health problem that causes an organ not to function properly there is a patient who will not get better unless they receive a substitute in a timely manner, it would certainly be unethical to turn this person back onto the street because there is no option for them. Organs don't just grow on trees, yet.

When the only option is a manufactured organ, it's a necessity for modern health care. I'm very clearly not a doctor or scientist of any kind, so my knowledge of stem cells begins and ends with knowing that scientists can do all kinds of things with these cells and they are very versatile. Stem cells are a fantastic asset when it comes to medicine and they can play a big part in organ growth.

In my mind, there isn't really a question of ethics that surrounds stem cells. They are simply a new and effective tool used to combat numerous health problems. If they are used to grow my neighbour a new kidney, then the only moral dilemma I can think of is if they were actively refusing to create this kidney and wouldn't give him any kind of help.

Stem cells lying beneath the skin can be used to engineer new skin tissue that can be grafted on to burn victims. There just isn't an ethical issue there that I can see.

People who are ill deserve our help, and we are obligated to make sure everyone is taken care of.

She said

I once read a book about a young man who lived his entire life only to learn he was a clone created with the intention of eventually having his organs harvested to keep an aging billionaire alive and being evil, and I kind of thought this was a bad idea; I mean, raising a person just to execute him just because you want his kidneys? Dislike.

That being said, I'm not opposed to creating organs. If scientists can grow fully functioning livers in petri dishes and use them to save the lives of so many waiting for an organ donation, that's pretty great. Considering the fact that so many organs (i.e. hearts) can't be donated unless the organ's original donor dies, so a liver grown in a lab from completely harmless cells is A-OK with me.

I do worry about the evil this could span. Will these organs only be available to the super rich, like the villain in my novel? Will it eventually lead to raising people full of healthy organs meant to be donated? Or will it create creepy, floating torsos in tanks in labs, so passersby will be horrified by the sight?
If these scientifically grown organs can be offered to the masses, to the people who would otherwise die without new organs, I'm totally in favour. If the organs will become another commodity to be sold off to the highest bidder, and used to keep the world's wealthy healthier, longer, then I'm not really cool with that. Make it equal and fair for all, though, and you've got a deal.

Notes

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