

How have microscopes helped us to understand cell structure?

Introduction

In GCSE Biology you will learn about the detailed structure inside a living cell. But have you considered how it is possible to see these structures when a cell is so small that more than 100 could fit on the head of a pin?

Scientists have worked on this problem for over 400 years. The result of this work has been the invention of microscopes and the gradual increase in the magnifying power of these microscopes. You could research the several scientists who have won Nobel prizes for their work in this field.

The first microscopes allowed us to see tiny plankton. Now powerful electron microscopes allow us to see minute details inside cells. We can magnify something more than 500 000 times. We are even beginning to see the shapes of molecules like DNA.

By the time you complete your GCSE Biology studies you will know a lot of exciting facts – so why keep them to yourself?

In this WebQuest you will research the history of microscopes, with a special focus on how the gradual developments and improvements have helped us to understand the structure inside a living cell.

You will then present your findings as a PowerPoint demonstration for parents/guardians to watch so that they too can understand how scientists have been able to explore the amazing miniature world of the cell.

Your learning objectives:

- know the different types of microscope and their magnifying powers
- understand that light microscopes only allow us to see larger cell details such as nucleus, chloroplast
- know that modern electron microscopes allow us to see tiny cell structures such as mitochondria, ribosomes and the cell membrane.

Task

First, you need to make sure you understand two key terms: magnification and resolution. Next you need to be clear about the structures that are inside a cell so that you can concentrate on describing how microscopes have helped to see and understand them. You will then be able to research the microscope facts that you need.

Try and make your presentation last between 5–10 minutes. Remember that your audience may not have as much specialist science knowledge as you, so think about the language you will be using to explain your story.

Slides that have clear images and brief text, such as bullet points, work well. Make sure that the text is large enough to read easily.

Make sure you get permission to use any illustrations/photographs.

Your last slide could be a summary timeline, matching inventions with observations.

By the end of your presentation your audience should:

- understand a little about the need for good magnification and resolution
- know the different types of microscope
- know what is inside a cell and how different structures have been revealed as a result of microscopes advancing
- know one example of why microscopes have helped to understand disease.

Process

Begin by checking that you understand the two key terms: magnification and resolution. Use your Student Book to help you get started. For more details, use the sources listed later in this task. Make a note of the key words that will allow you to explain these terms.

Next, you need to be clear about the structures that are inside a cell so that you can concentrate on describing how microscopes have helped to see and understand them. Begin by concentrating on the features that are listed in your syllabus. These are described in the Student Book. You may like to stretch yourselves a bit more and find some extra features that are normally not discussed until A level. Make a list of the features.

You will then be able to research the microscope facts that you need. You will need to do the following tasks:

- make a slide to explain the key terms (magnification and resolution)
- find out details about the different types of microscope. For each type of microscope, find out when it was invented and by who and a little bit about how it works
- find out about a medical advance that has been possible because of microscopes.

As you write the presentation, remember to concentrate on how each new development and invention allowed scientists to see extra detail in cells.

Put the slides together in an order that is clear and logical. Prepare a short text to use for each slide. Practise your presentation to make sure that the:

- presentation is the right length
- you speak slowly and clearly enough to be easily understood
- correct fonts on slides are used so that they show up well and can be read from the back of the room.

Sources

A timeline for microscope developments

Helps to put the inventions in the right order and time context.

<https://www.microscopemaster.com/microscope-timeline.html>

Size of cells and microbes

An interactive to help understand the relative sizes of biological objects and the magnification required to see them.

<https://learn.genetics.utah.edu/content/cells/scale/>

History of the microscope

Helps to understand the light or compound microscope.

<https://www.visioneng.com/resources/history-of-the-microscope/>

History of electron microscopes in cell biology

A detailed article with a lot of information as well as a timeline summary of developments in cell observation.

http://www.fen.bilkent.edu.tr/~physics/news/masters/ELS_HistoryEM.pdf

Electron microscopes

Article explaining how electron microscopes work, with a comparison with light microscopes.

<https://www.scienceabc.com/innovation/what-is-an-electron-microscope-how-does-it-work.html>

Metric system of measurement

Gives information about the tiny units used to measure cells and an idea of scale.

<https://www.mathsisfun.com/measure/metric-system.html>

The first use of the microscope in medicine

Describes a very early medical use.

<http://www.annclinlabsci.org/content/32/3/309.full>

What do doctors look for in biopsy and cytology specimens?

An example of microscopes being applied in medical work to diagnose and understand cancer.

<https://www.cancer.org/treatment/understanding-your-diagnosis/tests/testing-biopsy-and-cytology-specimens-for-cancer/what-doctors-look-for.html>

Conclusion

This activity should have helped you to understand more about how microscopes work and how they have helped us to understand the structure of cells.

You should now write a short summary of the information in your own words so that you have something clear to look back on.

You might also like to consider these questions:

- What was the most important technical microscope discovery and why?
- Do you think there is a limit to the size of things that we will eventually be able to see with new microscopes?
- What other areas of science have been helped by microscopes? Which area of science has been helped the most in your view?

Stem cell research

Introduction

In this WebQuest you will look at the arguments for and against the issue of using embryonic stem cells in research.

Stem cells are non-specialised cells that have the potential to create other types of specific cells, such as blood, brain, or muscle cells. Some stem cells have the potential to repair or replace damaged tissues or cells. Human stem cells can be found in human embryos. They develop from a female egg after it has been fertilised by sperm. The process takes 4–5 days.

Scientists use stem cells in research. This involves taking tissue from an aborted embryo or a spare embryo from fertility treatment. The cells are grown in a laboratory and tests are carried out on them. This research can provide knowledge for scientific and medical purposes.

Task

In this task you are going to write an article in support of embryonic stem cell research. You first need to ensure that you understand what this concept means. You then need to gather information on how stem cell research is used to help medical conditions and what the process involves. You will learn that it is a highly controversial issue and the reasons why many people are against it.

Following your initial research you will need to look in more depth at the pros and cons of embryonic stem cell research. You will then need to write an article in support of stem cell research. This will mean you need to come up with arguments that counter some of the 'against' arguments.

Process

Step 1: Research You need to do some research about the issue.

Using the sources provided, find out as much as you can about:

- what stem cells are
- where are they found
- what the process of embryonic stem cell research is
- how stem cells are used to help medical conditions
- why people object to stem cell research.

Step 2: Write an article in support of stem cell research

In your article you need to explain:

- what stem cell research is
- how stem cells have been used to help medical conditions
- how scientists hope that stem cells might be used in the future to help medical conditions
- why, although there are objections to stem cell research, it is important that this research is allowed to go ahead.

Sources

Pros and cons of stem cell research

A good explanation of what stem cell research is. Covers the pros and cons of how the knowledge is used and concerns about the methods.

<https://explorable.com/stem-cell-pros-and-cons>

A good explanation of what stem cells are, where they come from, and the issues of embryonic stem cells.

<https://www.allaboutpopularissues.org/pros-and-cons-of-stem-cell-research.htm>

An ethical dilemma

A EuroStemCell article looking into the ethical issues surrounding embryonic stem cell research.

<https://www.eurostemcell.org/embryonic-stem-cell-research-ethical-dilemma>

Stem cell controversy

This article looks at alternative research methods.

<http://www.explorestemcells.co.uk/StemCellControversy.html>

A submission to the House of Lords Select Committee on stem cell research

A very detailed article looking at the cons of stem cell research.

<https://publications.parliament.uk/pa/ld200102/ldselect/ldstem/83/8301.htm>

Top 10 arguments against stem cell research

Arguments against the use of stem cell research.

<https://healtharticles101.com/top-10-arguments-against-stem-cell-research/>

Conclusion

What did you learn?

You probably feel quite strongly about the issue after researching some arguments for and against it.

Think about how you feel about the issue. Do you support stem cell research or not?

Food nutrients and their function

Introduction

Food scientists and dieticians work with the Food Standards Agency to promote good eating habits and to ensure that our food is safe and is labelled correctly.

Information on what makes up a healthy diet can sometimes be confusing.

On 7 April 2010, BBC News reported on results of a study involving 500 000 Europeans, which showed that eating five fruits and vegetables a day may not decrease cancer rates.

In this WebQuest you will take on the role of food scientist. You will be required to produce a presentation summarising clear and accurate scientific information about the importance of a healthy diet.

Task

In this activity you are going to research the types of nutrients required by the human body to carry out the vital functions of life such as respiration, movement, growth and repair of body tissue.

Having developed an understanding of the role of various nutrients in maintaining a healthy body, you need to:

1. put together a healthy eating plan for students
2. present your plan.

Your healthy eating plan should consist of:

- examples of three healthy lunches
- scientific information to persuade your audience to adopt your plan.

For your presentation, you may choose between:

- a PowerPoint presentation for students
- a letter to the head teacher of a school.

Make sure you communicate your healthy eating plan as effectively as possible. Think about your audience and how best to reach them.

Process

Step 1: Responsibilities

The web links included on the Sources page will be useful for helping you to gather information for this task.

Gather information on each of the following:

- the role and sources of carbohydrates
- the role and sources of proteins
- the role and sources of saturated and unsaturated fats
- the role and sources of vitamins and minerals

- the health risks of eating too much saturated fat, sugar and salt
- the importance of fibre
- the importance of controlling overall energy intake.

Step 2: Research

You should focus on collecting some scientific information relating to each of the bullet points above. For more information, refer to B3.3 The chemistry of food in your Student Book and the links on the Sources page.

Step 3: Presentation

You need to select the relevant information for the task and then decide the best way to communicate your findings, either a PowerPoint presentation or a letter to the head teacher of a school.

Sources

Diabetes Forecast: How the body uses carbohydrates, fats, and proteins

Exploration of the role of carbohydrates, fats, and proteins in maintaining a healthy body.

<http://www.diabetesforecast.org/2011/mar/how-the-body-uses-carbohydrates-proteins-and-fats.html?referrer=https://www.google.co.uk/>

Netdoctor: Vitamins and minerals – what do they do?

Explanation of the role of vitamins and minerals in a healthy diet, as well as details of signs of deficiency.

<https://www.netdoctor.co.uk/healthy-eating/a10801/vitamins-and-minerals-what-do-they-do/>

British Heart Foundation: Healthy eating

A look at some of the benefits of a healthy diet, and of the health risks of excess salt and fat.

<https://www.bhf.org.uk/informationsupport/support/healthy-living/healthy-eating>

Conclusion

You should now be able to describe and explain the following key points about nutrients and their function in the body:

- that the body requires a variety of nutrients in order to carry out vital functions
- the major types of nutrients required to maintain a healthy body
- which foods are rich in which nutrients
- the health risks of eating too much fat, sugar or salt
- the importance of overall energy intake.

Enzymes in industry

Introduction

When you studied the human digestive system, you learned about digestive enzymes. Refer to B3, Organisation and the digestive system of your Student Book for further information.

You will know that in the digestive system, three main types of enzymes are used to break down food:

- proteases to digest proteins (meat, for example)
- lipases to digest lipids (fats and oils)
- carbohydrase to digest carbohydrates (sugars and starches).

Knowledge about the way these enzymes work has allowed them to be purified and then used for industrial and medical applications. This WebQuest is about those industrial applications of enzymes.

In this WebQuest, you will research the ways in which enzymes can be put to use, with a focus on the three main categories of digestive enzymes. You will present your findings as a wallchart so that everyone visiting your classroom will be able to find out about this for themselves.

Task

Start off by deciding the format of the wallchart. You will then need to find out about one application of each type of enzyme.

The wallchart needs to be bright and informative. This means there will need to be some suitable pictures. If you use pictures you will need to make sure that their sources are clearly acknowledged.

By the end of the task you should have a large wallchart that:

- is easy to read
- includes clear information
- has illustrations and colour
- includes well-described examples of how each type of enzyme is used for an industrial or medical process
- includes facts that will attract and interest the reader.

Process

Step 1: Begin by carrying out some preliminary research to find out the main applications of the enzymes. Remember to focus on the three main types of enzyme: proteases, lipases, and carbohydrases.

Step 2: Make a list of these applications and check that you are clear about which ones involve the three enzyme types.

Step 3: Next, plan how you will include these applications on your wallchart. The text will need to be large enough to read easily from a distance. This means that the text font size will be large, so you will need to be concise and clear in choosing how to use the right words

to describe the information. You will also need to decide on the font style to use. Remember that it needs to be easy to read.

Step 5: Now you need to look at the space you have available for the chart. Decide how large each section can be so that there is room for them all.

Step 6: Finally, you need to assemble the wallchart. You might like to use borders and highlighting to make the sections stand out. Include an overall title banner at the top.

Sources

Enzymes and their uses

Information about some uses of enzymes.

<https://www.abpischools.org.uk/topic/enzymes/>

Enzymes in industry

A video made by another student on enzyme applications.

<https://www.youtube.com/watch?v=O1eshQtflrw>

The Applications of Enzymes in Industry and Medicine

A site listing some examples of applications.

<https://h2g2.com/entry/A1125721>

Meat Tenderizers & Enzymes

Source about meat tenderisers.

<https://www.livestrong.com/article/277889-meat-tenderizers-enzymes/>

Enzymes Used in the Dairy Industry

Examples of enzymes in the dairy industry, especially cheese making.

<https://www.thespruceeats.com/enzymes-used-in-the-dairy-industry-375519>

Applications of Enzymes in Food Industry

A slideshow about enzyme uses.

<https://www.slideshare.net/abhishek198thakur/applications-of-enzymes-in-food-industry>

Why are enzymes used in baby food?

About the enzymes used in baby food.

<https://infograph.venngage.com/p/202026/baby-food>

The use of proteases in the leather and wool industries

A short article about the leather and textile applications.

<http://www1.lsbu.ac.uk/water/enztech/leather.html>

Nattokinase: The Japanese Clot-Busting Miracle

Article about an enzyme in food that helps with blood clots.

<https://www.webmd.com/vitamins/ai/ingredientmono-1084/nattokinase>

Proteins to Dissolve Blood Clots

Article with information about some naturally occurring enzymes that treat blood clots.

<https://healthfully.com/proteins-to-dissolve-blood-clots-6575946.html>

Conclusion

Remember that your focus is on understanding the three digestive enzyme types. You should have found that they can be used in all sorts of applications. Some of these may have surprised you!

It would be a good idea to make a summary table to put with your notes, including some examples of each type of enzyme.

Heart transplants

Introduction

Heart disease is the most common cause of premature death in the UK and the USA and has been linked with lifestyle factors, for example diet. With so many cases to be treated, it is hardly surprising that so much research has gone into heart transplant technologies.

In this WebQuest, you will research the history of heart transplants and understand the technical difficulties associated with such major surgery. You will also research alternative sources of hearts to be used for transplants.

Your learning objectives are:

- develop a brief summary of the history of heart transplant surgery
- understand the difficulties associated with sourcing and transplanting hearts
- understand the role of immunosuppressant drugs following heart surgery
- research possible new sources of hearts.

Task

Your aim is to produce a slideshow about heart transplants which includes:

- the historical development of the medical technique
- how the transplant operation is carried out
- issues surrounding care of the patient
- ethical points of view
- possible future developments in the field of heart transplant surgery.

You will need to produce enough slides to last about 10 minutes.

Process

You should research the historical part of the story, some statistical data about transplants and waiting lists, the technical side of such an operation and the difficulties involved with patient care (including the role of drugs like immunosuppressants), and the ethical side of the story (including alternative surgeries and sources of hearts, like hearts from animals and cloned organs).

Now decide on a suitable format for the slideshow. For example, for a 10 minute show you will need 10–12 slides. When presenting, make sure that you speak slowly and clearly enough to be easily understood.

Check that illustrations such as graphs, data tables are not too cluttered, with clear units and titles. Keep any blocks of text brief! Choose a suitable font and size so that all information is easy to read from the back of a room.

Sources

A brief history of Heart Transplants

TIME article about the first infant cross-species heart transplants.

<http://content.time.com/time/health/article/0,8599,1939493,00.html>

A Brief History of Heart Transplantation

Columbia university article about history of heart transplants, including coronary assist devices and mechanical hearts.

<https://columbiasurgery.org/brief-history-transplantation-nypcolumbia>

Organ Donation and Transplantation Activity Data

Data on donors and waiting lists in the UK.

<https://nhsbtdeb.blob.core.windows.net/umbraco-assets/1070/england.pdf>

Heart Transplant

Introducing the different transplant procedure types.

<https://transplantliving.org/organ-facts/heart/>

Heart Transplantation Procedure

Information about the procedure as well as the risks involved and what happens afterwards.

<https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/heart-transplant>

Care of the heart transplant patient

Information about patient care before, during and after the procedure

<https://www.nursingtimes.net/clinical-archive/cardiovascular-clinical-archive/care-of-the-heart-transplant-patient-09-07-2002/>

Living with immunosuppression after an organ transplant

Article about immunosuppressants and post-operative precautions

<https://www.webmd.com/a-to-z-guides/organ-transplants-antirejection-medicines-topic-overview#1>

Coming age of Xenotransplantation: Would you accept an organ from a pig to save your life?

Introducing Xenotransplantation

<https://geneticliteracyproject.org/2015/02/12/coming-age-of-xenotransplantation-would-you-accept-an-organ-from-a-pig-to-save-your-life/>

Heart failure: transplantation of animal organs into human patients 'more viable'

Link between genetic modification and xenotransplantation

<https://www.medicalnewstoday.com/articles/281278>

Could we clone our organs to be used in a transplant?

Article looking at the possibility of cloning organs for transplant

<https://science.howstuffworks.com/life/genetic/cloned-organ-transplant.htm>

Conclusion

This activity should have helped you to understand heart transplant surgeries and uses of alternative methods, for example, using cross-species hearts.

In your own words, you should now write a short summary of the information you have gathered so that you have something clear to look back on when you revise. Make sure that you include notes so that you understand:

- the difficulties associated with sourcing and transplanting hearts
- the role of immunosuppressant drugs following heart surgery and link this with your knowledge of the immune system
- possible future new sources of hearts and associated ethical problems.

You might also like to consider how adjusting lifestyle can help a person to minimise the risks of needing a heart transplant at all.

The MMR controversy

Introduction

When you studied communicable diseases you learned how vaccination is used to prevent the spread of disease in populations. You will know that if most people in a population have been vaccinated, then the chances of spread are very small.

The story you will research in this WebQuest has been described as one of the biggest public health controversies in British medical history. In 1988, a triple vaccine called MMR was introduced so that children could be simultaneously vaccinated against measles, mumps and rubella. These are diseases that can kill.

Children were vaccinated as part of a national programme, producing an effect known as herd immunity. Herd immunity relies on the majority of people being vaccinated, so that an infected person is always likely to be surrounded by immune people so the infection cannot spread.

In 1998, a doctor published his idea that the MMR vaccine was linked to autism. This caused a widespread parental panic as this idea was spread by the media and over the next few years many parents refused to have their children vaccinated. The doctor's claims were later shown to be untrue.

Your learning objectives are to:

- understand the importance of large-scale vaccination programmes
- understand that scientists need to communicate clearly so that the public understand what they are saying
- understand that scientists need to check their work and conclusions very carefully before exposing their findings to the public
- understand that scientific discoveries need to be checked by other scientists (peer-checked) to see if their work is reproducible.

Task

The task here is to prepare a short presentation about the MMR vaccine scare.

This report could be in the style of a news report aimed at explaining the facts to a group of parents who are worried about the vaccine. The report should be about 8 minutes long.

Remember that the audience will not have specialist knowledge. You will need to be clear with the facts and use illustrations to help with any explanation.

By the end of your presentation the audience should:

- understand why it is so important to have children vaccinated and be clear about the risks of lack of vaccination cover in a population
- understand that the MMR scare started because of a report that had not been checked fully enough by other scientists
- be reassured that evidence for other studies does not support the claims that the MMR vaccine is a risk.

Process

Step 1: You should make sure you:

- explain about the importance of vaccination programmes and describe what the MMR actually does. The idea of herd immunity should be explained.
- describe the claims made by Andrew Wakefield and why he made them. You should also explain why his claims led to such public fear about the vaccine, and how having Andrew Wakefield's work peer-checked has provided evidence that contradicts his theory.
- explain how the drop in MMR cover may be linked with an increase in measles outbreaks.

Step 2: You can use the list of web links that follow to help begin the research. Remember that there are other sources of information that could be useful too. You may like to interview your own doctor/nurse or a scientist who you know to get a first hand medical opinion.

Step 3: Once the information has been collected you will need to write the report. This can be in the form of a slide show.

Put the slides together in an order that is clear and logical – prepare a short text for each slide. Practise to make sure that:

- the presentation is the right length, clear, easily seen from back of room
- you speak clearly so that the audience understands.

Sources

Andrew Wakefield – the man behind the MMR controversy

An article about Dr Wakefield, discussing the main facts of the case.

<https://www.telegraph.co.uk/news/health/news/7091767/Andrew-Wakefield-the-man-behind-the-MMR-controversy.html>

Does the MMR Jab Cause Autism?

Describes work by another scientist to try and check Wakefield's claims.

http://www.bbc.co.uk/sn/tvradio/programmes/horizon/mmr_prog_summary.shtml

Vaccination Controversy: No Autism, MMR Vaccine Link, New Study Finds

Describes new work that contradicts Wakefield's claim.

<https://www.ibtimes.com/vaccination-controversy-no-autism-mmr-vaccine-link-new-study-finds-1891420>

MMR vaccine

NHS information about the vaccine.

<https://www.nhs.uk/conditions/vaccinations/mmr-vaccine/>

No link between MMR and autism, major study concludes

Recent article summarising research findings.

<https://www.theguardian.com/society/2015/apr/21/no-link-between-mmr-and-autism-major-study-concludes>

Measles-Mumps-Rubella (MMR) Vaccine and Autism Studies

Site with links to research by other people checking the claims about MMR and autism.

<https://www.vaccinateyourfamily.org/which-vaccines-does-my-family-need/babies-children/>

The UK immunisation schedule

Details about when children should have their vaccines to different diseases in the UK.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/855727/Greenbook_chapter_11_UK_Immunisation_schedule.pdf

Doctor blames discredited autism research for measles outbreak

Video and article links lack of MMR cover with measles outbreak.

<https://www.cbsnews.com/news/doctor-blames-discredited-autism-vaccine-link-research-for-measles-outbreak/>

Image

Chart relating MMR cover to measles cases.

https://farm9.staticflickr.com/8012/7606679038_8bf243e347.jpg

What is herd immunity?

Explanation of herd immunity, with a video clip.

<https://www.vaccinestoday.eu/stories/what-is-herd-immunity/>

Conclusion

Now that you have looked at a particular vaccination programme in detail, write a short summary of herd immunity and why it is so important in controlling the spread of certain diseases in a population.

You should also write about why it is important for scientific research to be reproducible, so that it can be checked by other scientists before being reported accurately to the public.

The World's worst pathogen

Introduction

Pathogens are organisms that cause diseases. There has been great focus recently in the media about the increasing problem of antibiotic resistance in bacterial pathogens, with the threat of huge increases in death rates worldwide.

Killer diseases have been well documented – so which is the worst pathogen?

Could it be the one that spreads most easily? Perhaps the one with the highest death toll? Or maybe the one that cannot be treated or for which no vaccine currently exists?

In this WebQuest, you are going to be finding out about different pathogens. You will identify the pathogen you think is the worst and report back as to why you think this.

Your learning objectives are to understand:

- what a pathogen is
- the terms epidemic and pandemic
- the different ways in which pathogens can spread
- reasons why different pathogens are considered to be so dangerous to human life.

Task

Your task is to produce a short presentation to persuade an audience why your chosen pathogen is the worst one.

The final outcome might be a debate where more than one person presents their case to explain why their chosen organism is the worst pathogen.

Process

The first step is to collect a list of the pathogens and the killer diseases that they cause. When you do this, think about the different reasons why diseases might be considered so bad. Once this list has been drawn up, you should choose one disease to present on.

Now collect information about your disease. Remember you are going to try and persuade an audience why it is the worst!

A disease that flares up quickly and kills a lot of people is dramatic, but is it as bad as one that is always present at a lower level? What about one that is not easily treatable?

Think about things like:

- statistics about the disease - how many people actually die?
- mutation rate
- antibiotic resistance
- ease of spread and infection
- difficulty of treating the disease
- death rates across time
- the chances of epidemic or pandemic
- diseases carried by vectors

- diseases that could spread due to global warming
- possibility of vaccination
- limitations due to costs of treatment
- geography, e.g., if it matters where you live in the world.

After collecting your evidence, put together a short presentation to last no longer than five minutes. This could use one or two slides. Make sure that your slides are easy to read and that there is not too much information to take in at once.

Check that any illustrations such as graphs, and data tables are not too cluttered, with clear units and titles. Keep any blocks of text brief! Choose a suitable font and size so that all information should be easy to read from the back of a room.

Sources

The 9 Deadliest Viruses on Earth

Viral diseases that cause high death rates.

<https://www.livescience.com/56598-deadliest-viruses-on-earth.html>

England's chief medical officer warns of 'antibiotic apocalypse'

News article in 2016 warning about the rise of antibiotic resistant bacteria.

<https://www.theguardian.com/society/2016/may/19/englands-chief-medical-officer-warns-of-antibiotic-apocalypse>

Global Killers

Article about deadly infectious diseases.

<http://needtoknow.nas.edu/id/threats/global-killers/>

WHO: Waterborne Disease is World's Leading Killer

Focusing on water borne diseases and their death tolls.

<https://www.voanews.com/archive/who-waterborne-disease-worlds-leading-killer>

The biggest killer diseases in history

Contains some numerical stats on diseases.

<https://businesstech.co.za/news/general/71652/the-biggest-killer-diseases-in-history/>

10 Killer Super Bugs Confronting Modern Medicine

Article about resistant organisms.

<https://www.bestnursingmasters.com/10-killer-super-bugs-confronting-modern-medicine/>

TB beats HIV as the leading infectious disease cause of death worldwide

Recent article about the increase in TB.

<https://www.usnews.com/news/articles/2015/10/28/tuberculosis-passes-hiv-as-no-1-infectious-disease>

Infectious diseases

WHO site which needs a bit of careful searching but contains statistical and other information.

https://www.who.int/topics/infectious_diseases/en/

Conclusion

Did you manage to decide about the 'worst pathogen'?

By now you will have a lot of information about different diseases. In your own words, you should now write a short summary of the information you have gathered so that you have something clear to look back on. Make sure that you include notes so that you understand why certain diseases are considered to be so bad.

Include a paragraph or two about how people can protect themselves through careful lifestyle choices and sensible use of medicines.

Medicines from plants

Introduction

In GCSE Biology, you have learnt about disease and the constant battle against it. You will have learnt about antibiotics and painkillers and the types of disease that they combated. You will also know that some diseases are becoming resistant to antibiotics. A famous and recent example includes MRSA – the 'hospital superbug'.

Imagine how serious it would be if untreatable killer diseases affected crowded human populations.

The scientific and medical world is constantly on the lookout for new types of medicines and drugs. Many could come from plants, but only a tiny fraction of the plant world has been studied. Plant species become extinct every year due to loss of habitat, deforestation and other human interference. Loss of rainforests also displaces indigenous people who traditionally know how to use plant medicine. It is becoming more and more urgent that we look at the plant world much harder while we still have the chance.

This WebQuest is all about medicines that have been found and which are used regularly. You are likely to have used them yourselves.

Your learning objectives are:

- to know some examples of medicines that have come from plants
- to understand a little about how such medicines are purified and tested.

Task

Your aim is to produce an informative and colourful presentation about medicines from plants. This could be a slide show, or you might prefer to make a large wallchart. If you choose a slide show, it will need to be about 10 minutes long. If you choose a wallchart, then it will need to have large images and clear text that can easily be read from the back of the class.

After viewing the slide show or wallchart, your audience should:

- understand that plants are a good source of medicines
- know some examples of such medicines
- understand a bit about the extraction of the chemicals from the plants
- know about the strict procedures involved with testing new medicines
- realise how important it is that humans conserve plant species and their habitats because potentially there are still medicines out there yet to be discovered.

Process

Step 1: You should first concentrate on finding examples of plant medicines and their sources. Try to include the common as well as the scientific names of the plants. Don't forget to say where the plants are found!

Here are some examples to get you started. You should include some of these in your final presentation.

Plant	Medicine	Use
Pacific yew	Taxol	Cancer treatment
Willow	Aspirin	Painkiller
Cinchona	Quinine	Anti-malarial
Foxglove	Digoxin	Cardiac arrhythmia
Curare	Tubocurarine	Muscle relaxant for surgery
Nightshade	Atropine	Pupil dilator in eye examinations
Eucalyptus	Menthol	Cough medicines
Opium poppy	Morphine	Painkiller

Step 2: Find out about how the chemicals are extracted and purified, and about how new drugs are tested before being licensed for use in humans.

Step 3: Check that the information you include is easy to understand, and you've included clear images. You may need to use a glossary to explain complex terms.

Check that any slides or posters can be read easily. Do not include large blocks of text – use short punchy bullet points to get the information across briefly and clearly.

You may wish to include some historical detail. For example, the use of plants as natural remedies goes back thousands of years.

You might also include some predictions about possible medical advances that plants might bring in the future.

Sources

Plant-Based Drugs and Medicines

An article that includes a long list of drugs and chemicals from plants listed under their scientific names.

<http://www.rain-tree.com/plantdrugs.htm#VqUDLiqLSUK>

Plant Medicines A–Z

A searchable site with lots of information and further links.

<http://www.medicinehunter.com/plant-medicines>

Historical review of medicinal plants' usage

A good article about the history of plant medicines.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3358962/>

Extraction, Isolation and Characterization of Bioactive Compounds from Plants' Extracts

A more complicated article, but with some useful information about how to extract the chemicals from the plants.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3218439/>

Phytochemical extraction

A slide show about extraction of chemicals from plants.

<https://www.slideshare.net/Sindhukuberappa/phytochemical-extraction>

Screening Plants for New Medicines

Article about the uses of herbal drugs in different countries.

<https://www.ncbi.nlm.nih.gov/books/NBK219315/>

The medicine development process

A timeline about testing new medicines before they can be used.

<https://www.mstrust.org.uk/a-z/drug-development-process>

Medicines information – Licensing

An NHS article explaining how medicines are developed and tested.

<https://www.nhs.uk/conditions/medicines-information/>

Conclusion

This activity should have stimulated your curiosity about plant medicines. They are much more widespread than you may have originally thought!

You should now write a short summary to include a brief section on:

- two or three common plant medicines and their sources
- how chemicals are extracted and tested before being used by humans
- why it is important to conserve habitats with plants that could yet prove to be lifesavers.

Something fishy about photosynthesis

Introduction

In GCSE Biology, you have learnt about photosynthesis and the conditions that help it to occur. You will know that it is not just green plants that photosynthesise. Some kinds of bacteria and algae also use photosynthesis to produce carbohydrates.

Algae can grow very quickly under the right conditions and are a valuable food source for fish, other animals and even humans. The mass production of algae is used to generate biomass that can be made into animal feeds as well as algal supplements for human diets.

Growing algae can involve something as simple as an aquarium in your own home, but producing very large quantities requires the type of brightly lit and warm conditions that can be found in tropical and subtropical countries.

This WebQuest is all about the production of food from algae.

Your learning objectives are:

- understand how the control of photosynthetic limiting factors can result in the rapid growth of algae
- understand how the algae produced can be used in animal foods
- weigh up the possible advantages of algae in human diets.

Task

Your aim is to present a short illustrated talk about algae as food.

Your talk should be about 10 minutes long. It should be illustrated with slides and clearly explained.

The talk should be divided into sections:

- How can algae be grown in very large quantities to produce animal foods such as fish flakes?
- How can algae be grown at home for small-scale food production?
- Is there a health benefit from eating algae?
- What are the possible economic and environmental effects of this biotechnology?

Process

Step 1: You should research the growth of algae in tropical countries. Find out how the algae are harvested and processed to make fish food or other animal feed. You may like to think about the possible economic benefits.

You should also find out how algae can be grown in the home and used for human food, and the possible health benefits.

Step 2: Once the information has been gathered, design a suitable slideshow. Check that the information is easy to understand.

Choose clear illustrations for the slides and keep text to a minimum. Avoid big blocks of text. It is best to use a few short bullet points. Make sure that the text is big enough to read at the back of the room.

If the show is 10 minutes, then 12-15 slides will be enough.

Sources

Microalgae in feeds

A source describing how algae are used in different animal feeds.

<https://www.allaboutfeed.net/Raw-Materials/Articles/2014/5/Microalgae-in-animal-feed-1458810W/>

Promising alternative feeds for aquaculture

Three alternative feeds for fish.

<https://medium.com/sustainable-seafood/3-promising-alternative-feeds-for-aquaculture-2742c011e3cc>

Algae as fish feed

Includes details about the composition as well as the growth of the algae.

<http://studies-in-botany.blogspot.com/2014/02/algae-as-fish-feed.html>

All about Spirulina algae

What is Spirulina, health benefits, links to further sites.

<http://www.americanaquariumproducts.com/SpirulinaAlgae.html>

Commercial production of Spirulina report

Information about Spirulina production in India.

<https://www.scribd.com/document/119768582/Commercial-Production-of-Spirulina-Algae-KSIDC>

Development of a Spirulina Industry – Production

Article about commercial production of Spirulina in different countries.

<https://www.algaeindustrymagazine.com/special-report-spirulina-part-5-development-of-a-spirulina-industry-production/>

Commercial Spirulina Algae Farm in Thailand

Short film about an algae farm in Thailand, includes preparation information.

https://www.youtube.com/watch?v=7cc-6P_GY4I

Application of single cell protein

Information about culture of the algae in tropical countries.

<http://biomaster2011.blogspot.com/2011/03/single-cell-protein-from-spirulina.html>

Parry Nutraceuticals - Organic Spirulina Manufacturing process

Publicity film about growing algae in a tropical country.

https://www.youtube.com/watch?v=cQ_WrqrR_ul

Growing Spirulina at home

Magazine article about growing and harvesting the algae.

<https://www.algaeindustrymagazine.com/growing-spirulina-at-home/>

Spirulina

Report about production and health benefits.

http://www.oilgae.com/non_fuel_products/spirulina.html

Conclusion

Now that you know all about growing algae, you should write a short summary linking this information with your knowledge of photosynthesis.

How are manufacturers taking advantage of their knowledge of the limiting factors of photosynthesis to maximise production?

You may like to set up your own Spirulina production facility in the lab!

Did dinosaurs have warm blood?

Introduction

Having studied respiration during your course, you will know that some of the energy released may be used to warm up the blood in mammals and birds. This makes these animals more efficient and allows them to tolerate a wider range of ecological conditions.

Reptiles have cold blood. They are therefore dependent on warmth from the environment, such as the sun, to keep them warm and active.

Dinosaurs occupied most of the ecological habitats in the world for over 300 million years. How could they be so large, diverse and successful without having warm blood? Were they a special type of reptile, perhaps more like mammals than lizards?

Your learning objectives are:

- to understand the advantages of being warm-blooded
- to find out the features of animals that have warm blood and whether the dinosaurs shared those features
- to answer the question 'could the dinosaurs regulate their body temperatures like mammals?'

Task

Your task is to produce a report summarising the evidence for and against warm blood and temperature regulation in dinosaurs.

You should summarise your findings in the form of a slide show lasting no more than 10 minutes.

Your presentation will need to:

- explain why having warm blood can be an advantage to the life of an organism
- explain the features of dinosaurs that give evidence for them having warm blood
- allow your audience to decide whether they think dinosaurs had warm or cold blood.

Process

Step 1: First you will need to find out about why it is such an advantage to have warm blood.

Use examples of modern animals like birds and mammals to illustrate the range of lifestyles and habitats that are possible.

You should also find out about the possible evidence for warm-blooded body features in dinosaurs. You could look at ideas such as:

- growth rates
- bone structure
- insulating feathers
- physical activity levels
- body size.

You may find some more information from the following researchers who have studied this area:

- M.D. D'Emic
- J.M. Grady
- M. J. Benton

A book that challenged many old ideas about dinosaurs was *The Dinosaur Heresies*, written by Robert Bakker.

Step 2: Once the information has been gathered, design a suitable slideshow.

Check that the information is easy to understand. Choose clear illustrations for the slides and keep text to a minimum. Avoid big blocks of text. It is best to use a few short bullet points. Make sure that the text is big enough to read at the back of the room.

If the show is 10 minutes, then 12-15 slides will be enough.

Sources

Were dinosaurs warm-blooded?

Article about dinosaur growth rates with a video clip and more links.

<https://www.livescience.com/51162-dinosaurs-warm-blooded-growth-rates.html>

Hot-blooded or Cold-blooded?

Article with links to further summaries of the evidence for and against warm blood in dinosaurs.

<https://ucmp.berkeley.edu/diapsids/metabolism.html>

Were dinosaurs warm-blooded? The case for and against warm-blooded metabolisms in dinosaurs

Article with summary of evidence for and against warm blood theories.

<https://www.thoughtco.com/were-dinosaurs-warm-blooded-1092019>

Dinosaurs 'neither warm nor cold blooded'

This article has an intermediate position on the argument.

<https://www.bbc.co.uk/news/science-environment-27794723>

Hot-blooded or cold-blooded?

There are some named examples in this article.

<https://www.enchantedlearning.com/subjects/dinosaurs/anatomy/Blood.shtml>

Dinosaurs neither warm-blooded nor cold-blooded

Reports a metabolic analysis of different animals and lifestyles.

<https://www.nature.com/news/dinosaurs-neither-warm-blooded-nor-cold-blooded-1.15399>

Dinosaurs were likely warm-blooded

Recent article pushing the warm blood case.

<https://www.sciencedaily.com/releases/2015/05/150528140937.htm>

Fossilised eggshells help crack the mystery of how dinosaurs kept warm

Recent study of eggshells helps the debate.

<https://www.ibtimes.co.uk/fossilised-eggshells-help-crack-mystery-how-dinosaurs-kept-warm-1523995>

Fossils found in Siberia suggest all dinosaurs could have been feathered

Evidence for feathers on dinosaurs (insulation to keep heat in or cold out?).

<https://www.ibtimes.co.uk/fossilised-eggshells-help-crack-mystery-how-dinosaurs-kept-warm-1523995>

Warm and cold blooded

With a few exceptions, all mammals and birds are warm-blooded, and all reptiles, insects, arachnids, amphibians and fish are cold-blooded. What does it mean to be warm-blooded or cold-blooded? The temperature of an animal's blood is related to its body temperature.

http://coolcosmos.ipac.caltech.edu/image_galleries/ir_zoo/coldwarm.html

Warm-blooded vs. Cold-blooded: What's the difference?

Video talking about the difference between having warm and cold blood.

<https://www.seeker.com/warm-blooded-vs-cold-blooded-whats-the-difference-1792604551.html>

What is warm blooded?

Article looking at the advantages of warm blood.

<https://www.earthlife.net/mammals/warm.html>

Conclusion

Now you have found out about the debate over warm blood in dinosaurs, you should summarise some key points for your notes.

Can you make a clear summary link between the ability to thermoregulate and the ecology and lifestyle of living things?

The IVF debate

Introduction

In vitro fertilisation (IVF) is a method for generating fertilised embryos outside the body. It is commonly used to assist pregnancy and many people have been able to have children as a result.

The technique produces more embryos than necessary, so there are issues surrounding the storage, disposal, or use of the spare embryos. There is even a question about who has ownership of spare embryos.

If you were faced with the prospect of having to use IVF, would you? How might you react later on if somebody asks to use your spare embryos for medical research?

Your learning objectives are to:

- understand the process of IVF
- be able to evaluate the moral issues that arise through use of IVF technology and the embryos it produces.

Task

Your task is to produce a set of information cards that could be used in a class debate about IVF.

You will need cards with information about:

- the technique of IVF, embryo production, and how the embryos are used to produce pregnancy
- the issues surrounding donated eggs and sperm that may be used in IVF procedures
- the benefits and risks of IVF
- the storage, ownership, and disposal of IVF embryos
- the possibility of genetic testing of embryos and its implications
- the possible use of embryos to generate embryonic stem cells for research purposes
- the use of IVF techniques in other animals, for example in cloning.

Design the cards so that they can be used as a wall display when not in use for a debate.

Process

It would be sensible to start by deciding on the eventual appearance of your information cards. They will need to have plenty of points in order to allow a clear debate, but they also need to be easy to read so that they can be used as a wall display at other times.

You will need to consider things such as:

- size
- colour scheme
- type face and font size
- illustrations.

Begin by looking at the main points about the process itself, together with the benefits and risks associated with the treatment.

Research the issues about obtaining the sperm and eggs, storing or disposing of spare embryos, and the ways in which genetic testing could be involved and how this can be both a benefit and a morally questionable aspect of IVF.

You should also find out about the moral debate involved with using embryos for research, and how IVF is used in other animals, such as cattle, to produce embryos and allow cloning using embryo division. What are the moral issues now?

Once you have collected all the information, produce your cards. Remember that they need to be used as stimulus material for a debate, so there will need to be clear points that can be raised by the debaters.

You may find it helpful to divide the cards into positive and negative points of view.

Sources

IVF – What is in vitro fertilisation (IVF) and how does it work?

Information from the Human Fertilisation and Embryology Authority (HFEA)

<https://www.hfea.gov.uk/treatments/explore-all-treatments/in-vitro-fertilisation-ivf/>

What is IVF?

Includes a link with a downloadable information sheet. Has some illustration diagrams

<https://www.londonwomensclinic.com/fertility-treatments/ivf/>

Infertility Ethics

Article outlining the ethical and legal issues

<http://ministryofethics.co.uk/index.php?p=8&q=3>

Legal and ethical issues and fertility treatment abroad

Site focusing on the legal issues of going abroad for treatment

<https://fertility.treatmentabroad.com/going-abroad-for-treatment/ethical-and-legal-issues>

Destroying abandoned embryos 'ethically acceptable' for IVF clinics: U.S. doctors

News article about destroying spare embryos

<https://nationalpost.com/health/destroying-abandoned-embryos-ethically-acceptable-for-ivf-clinics-u-s-doctors>

The Ethical Considerations of Genetic Screening

Article looking at genetic screening of embryos: points for and against

<https://www.ndsu.edu/pubweb/~mcclean/plsc431/students98/christenson.htm>

IVF technique that tests embryos for genetic disorders has first success

News report about genetic screening

<https://www.theguardian.com/society/2014/jul/28/ivf-genetic-disorder-check-first-pregnancy-embryo-london>

Embryonic stem cell research: an ethical dilemma

Summarises the debate about use of embryos for stem cell research

<https://www.eurostemcell.org/embryonic-stem-cell-research-ethical-dilemma>

Key Ethical Issues in Embryonic Stem Cell Research

Australian report summarising many moral issues

https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/Publications_Archive/CIB/cib0203/03cib05

An insight into the ethical issues related to in vitro fertilization

A more detailed article with some detailed information

<http://ispub.com/IJH/6/1/4581>

Conclusion

Now that you have explored the science and moral issues about IVF, write a summary for your notes.

You should include a brief summary of the actual technique, together with a balanced set of points for and against IVF so that you are able to write an evaluation style question (six marks) about the pros and cons of IVF.

The 100 000 Genomes Project

Introduction

In 2012, the 100 000 Genomes Project was launched in the UK. Focusing on patients with cancer and rare diseases, the project collected complete genome sequences for 100 000 people by 2018.

The data collected by the project focuses on providing medical help to patients as well as driving forward medical knowledge. A genomic medical care system may be developed.

Although the project is based on an ethical and transparent programme involving full patient consent, there have been concerns about privacy of the data. For example, the possibility of using the genomic data for other purposes and the commercial aspect of using people's genetic information has been challenged.

Your learning objectives are to:

- describe the 100 000 Genomes Project
- understand the terms genome and genomics and genomic medicine
- understand the potential benefits of the project to medicine
- evaluate the ethical concerns that are associated with the project.

Task

Begin by checking that you all have a working understanding of the 100 000 Genomes Project. This will form the content that you will need to research and describe. Your task is to produce an information video about the 100 000 Genomes Project.

The first part of the video needs to clearly explain what the objective of the project is and why that is important. There will need to be clear explanations of terms such as genome and genomics.

The second part of the video should highlight any ethical issues and concerns. This section should not be judgmental but should include both sides of the arguments impartially.

By the end of this task, your video should include enough clear information to allow the audience to:

- understand what the 100 000 Genomes Project is
- understand the possible future benefits of genomic medicine
- evaluate (weigh up) both sides of the ethical arguments and concerns
- be able to argue clearly why they would or would not donate their own genomes for this type of research.

Process

Begin by deciding the format for your film. It could be based on an interview style or perhaps you might choose to a more interactive style.

You should find out about the genome project itself (for example, what is the aim of the project?), about the work that is being done, and reasons why the government has invested so heavily in it.

You should also find out about the potential benefits of the project (explaining what genomic medicine is and highlighting the possible benefits of the project to diagnosis and prediction of disease), and concerns surrounding the project (the possible commercial, privacy, legal and data sharing implications of the project).

Once the information has been collected, you need to design a storyboard (the order of your film) and script for the video before producing the final film. The final length of the video should be between five and ten minutes in length.

Sources

The 100 000 Genomes Project

Introduction and information guide to the project. Links from this to many other information pages in the site.

<https://www.genomicsengland.co.uk/about-genomics-england/the-100000-genomes-project/>

The 100 000 Genomes Project

Links to videos about the project.

<https://www.genomicsengland.co.uk/>

Genomics

NHS information site about the 100 000 Genomes Project.

<https://www.england.nhs.uk/genomics/>

Privacy and the 100 000 Genomes Project

Newspaper article about the privacy of data in the project.

<https://www.theguardian.com/science/political-science/2015/mar/10/privacy-and-the-100000-genome-project>

The Government seem more interested in our genes than our voices

Article that investigates some of the ethical points.

<https://www.theguardian.com/science/political-science/2016/mar/15/the-government-seem-more-interested-in-our-genes-than-our-voices>

Ethics and Genomic Research: 'Genomethics'

Article exploring the types of information that may be found by the genomics project.

<http://genomesunzipped.org/2012/01/genomethics.php>

How should we use clinical genomic data?

Article about access to the genomic data.

<https://sangerinstitute.blog/2013/12/17/how-should-we-use-clinical-genomic-data/>

Conclusion

In your own words, you should now write a short summary of the information you have gathered so that you have something clear to look back on when you revise. Make sure that you include some points from both sides of the ethical debate.

You might like to consider whether you would donate your own genome for such research.

What killed the mammoths?

Introduction

Woolly mammoths lived in the last ice age and died out about 3700 years ago. These iconic ice age mammals have inspired books and films and have been the subject of intensive fieldwork and laboratory research.

Specimens have been found frozen in Siberian ice, preserved so perfectly that even their hair is still present. Samples of mammoth blood have been recovered from this fossil and this has opened up a debate about the possibility of using cloning to bring the mammoth back from extinction.

This WebQuest is all about mammoth extinction.

Your learning objectives are to:

- understand that extinct organisms lived many years ago
- know that fossils are the remains of such organisms
- understand that fossils and rocks can be used to attempt to reconstruct past environments and events
- understand that in science there are still areas where exact proof is unavailable
- weigh up the evidence about the extinction of the woolly mammoths.

Task

Your task is to collect evidence for the different theories about the extinction of the woolly mammoths.

Using this evidence, you will produce a large wall display to summarise all the evidence and explain the different theories.

The display will need to be illustrated with plenty of pictures and clear text.

There are many theories, so you will need to concentrate on the most important ones first.

The display could be on a corridor wall so that it can be shared with everyone. Likewise, you could display it in the classroom/lab. Woolly mammoths are, after all, very popular – everyone should see them!

Process

Make sure you understand what the task involves. If in any doubt, ask your teacher. The first thing to do is to make up a list of the different theories.

Once your list has been completed, each entry on the list needs to be investigated.

Each theory needs to be explained using a clear summary poster, which clearly explains:

- the theory
- the evidence supporting each theory
- any evidence against the theory.

Check that any illustrations such as graphs, and data tables are not too cluttered with clear titles. Keep any blocks of text brief! Choose a suitable font and size so that all information is easy to read from the back of a room.

Try to create links with your knowledge of modern ecology to make the explanations come alive.

At the end of the display, add credits to include a list of your sources. You will need to include an acknowledgement list of any sources you have used for illustrations/photographs.

Sources

Why did the woolly mammoth become extinct?

Short article introducing several different theories

<https://www.reference.com/history/did-woolly-mammoth-become-extinct-5d31cab329d092d9>

Did global warming kill off the mammoths?

News article about global warming theory

<https://www.dailymail.co.uk/sciencetech/article-3172367/Did-global-warming-kill-mammoths-Rapid-climate-change-doomed-Ice-Age-giants-humans-study-suggests.html>

Humans DID kill off the woolly mammoth

News article about human effects theory

<https://www.dailymail.co.uk/sciencetech/article-3196817/It-humans-killed-mammoths-Spread-mankind-coincides-extinction-ice-age-beasts-claims-study.html>

What killed off the woolly mammoth? Climate change.

News article about climate change theory

<https://www.csmonitor.com/Science/2015/0724/What-killed-off-the-woolly-mammoth-Climate-change>

Climate change did not kill off the woolly mammoth

News article against climate change theory

<https://www.inquisitr.com/2339076/new-study-climate-change-did-not-kill-the-woolly-mammoth/>

What killed the woolly mammoth? New clues.

Article about changes in food availability for mammoths

<https://earthsky.org/earth/what-killed-the-woolly-mammoth-new-clues>

Mysterious Black Mats on Earth Not From Outer Space

Article introducing the idea of meteor strikes and extinction

<https://www.livescience.com/19844-cosmic-collision-black-mats-earth.html>

Did a Comet Really Kill the Mammoths 12,900 Years Ago?

Article introducing the idea of meteor strikes and extinction

<https://www.nationalgeographic.com/news/2013/9/130910-comet-impact-mammoths-climate-younger-dryas-quebec-science/>

Woolly Mammoth Gene Study Changes Extinction Theory

Article about genetic evidence

<https://www.sciencedaily.com/releases/2008/06/080611161038.htm>

Conclusion

You should now have a clear idea about the range of ideas to do with extinction of woolly mammoths.

You should also realise that evidence is still being gathered to help us understand what happened to them.

In your own words, you should now write a short summary of the information you have gathered so that you have something clear to look back on when you revise. Make sure that you include notes so that you understand the main theories. Decide which has the greatest chance of being true and explain why the evidence makes it convincing.

Life at the extreme

Introduction

Organisms have features that allow them to survive in the conditions where they normally live. You will be familiar with adaptations such as warm fur for insulation or camouflage to avoid predators. But what about adaptations that allow organisms to live in extreme environments? What about the extremes of temperature, pH or pressure? What about lack of oxygen or concentrations of noxious chemicals? How is it possible to live in water heated close to boiling point by volcanic activity or at pressures that would crush a person completely?

This WebQuest is all about those special organisms.

Your learning objectives are:

- understand what is meant by the term extremophile
- be able to name examples of extremophile organisms and explain how they are adapted
- know examples of bacteria that are extremophiles.

Task

In this task, you should produce a large wall chart. Extremophiles can be divided into categories, including:

- psychophilic
- thermophilic
- radio-resistant
- alkaliphilic
- acidophilic
- xerophilic
- barophilic
- endolithic
- anaerobic
- tolerant of toxic chemicals.

Your wall chart needs to include examples of each type of extremophile. It could use up a wall in your classroom or run along a corridor so that everyone can share it.

Process

You should begin by producing a summary introduction about extremophiles. This will need to:

- define what they are
- explain in general terms why they are so specialised
- introduce the different categories of extremophile

- explain why the study of extremophiles is both exciting and useful. For example, using enzymes from heat-tolerant organisms is useful in industry, while endolithic organisms could give clues about how life could exist on other planets.

Make this introduction clear and use brief points to keep your audience interested.

Next, collect examples of organisms to illustrate each category. You will need:

- clear pictures of the organisms
- an explanation of the problems they are adapted to face
- to explain how they are adapted/specialised to be able to cope with the conditions.

Make sure that you include examples from all the major groups of organisms, not just animals!

In the final display, you will need to have examples of:

- plants
- animals
- bacteria
- fungi
- protocistsans.

Once all the information has been collected, you need to work on the final display.

For each organism, make a clear section to add to the display. Each organism should have ample space, up to A3-sized, to include all the information and illustrations. This space could be any shape, so be creative!

You could decide on a theme, for example, use of colour or symbol coding, to identify the different categories of extremophile.

Use a standard type font so that the display works as a whole. You could use arial, or something similar, to make it easy to read. Text could be on coloured backgrounds – choose pale shades so the text stands out clearly.

The writing should be large so it can be read from at least a metre away. Use short bullet points and avoid big blocks of text. You could use font sizes such as 100 for headings, 48 for subheadings, 30 for text.

You could end the display with 'the most extreme organism' – you will need to decide what this is based on from your research.

Include a list of the sources that you have used at the end of the display.

Sources

Extreme Life

Lists the nine categories of extremophiles found on Earth.

<https://www.kevinabarnes.com/extreme-life/>

The life of extremophiles: Surviving in hostile habitats

Includes some examples from different categories of extremophile

<http://www.bbc.co.uk/nature/21923937?print=true>

11 Polar Sea Extremophiles

Examples from cold environments.

<https://www.mentalfloss.com/article/54493/11-polar-sea-extremophiles>

Extremophiles

Describes examples from several environments

<https://www.encyclopedia.com/science-and-technology/biology-and-genetics/biology-general/extremophiles>

Life In Extreme Environments

Interactive video about extremophiles with examples from around the world as well as speculation about extra-terrestrial life

<https://learn.genetics.utah.edu/content/astrobiology/environments/>

Most Extreme Extremophile

An example of a very resistant bacterium

<https://reasons.org/explore/blogs/todays-new-reason-to-believe/read/tnrtb/2011/03/21/most-extreme-extremophile>

Adaptations of Plants and Extremophiles – Ecology

A simple video introduction to extremophiles

<https://www.tes.com/teaching-resource/adaptations-of-plants-and-extremophiles-ecology-6303432>

How Extremophiles Work

Sorting extremophiles into categories

<https://science.howstuffworks.com/life/cellular-microscopic/extremophile1.htm>

The encyclopaedia of Earth: extremophile

Discusses the environments and gives some good details and examples

<https://editors.eol.org/eoearth/wiki/Extremophile>

Conclusion

Now that you are an expert on extremophiles, you should write a final summary for your notes to include a clear definition of what makes an organism and extremophile. Include a few examples of adaptations.

You should also consider why knowledge of extremophiles is important to humans.

Biological control

Introduction

The prickly pear cactus was introduced into Australia in the early 19th century. By 1900, it had spread so much that much of the grazing land in Queensland was overgrown. This was because the cactus had been introduced without the animal that normally eats it, so it was able to grow without any control.

In 1920, scientists introduced the moth *Cactoblastis cactorum*, the natural consumer of the cactus. Within 10 years the moth had done its job – the caterpillars had eaten an estimated 110 000 km² of the cactus and, as a result, brought it under control.

This is a dramatic example of biological control, where one organism is used to control the population of another.

This WebQuest is all about the relationship between the populations of predators and prey, and how predators can be used for biological control.

Your learning objectives are:

- understand the relationship between the populations of predator and prey
- know examples of predator–prey relationships in the wild
- know examples of biological control in human agricultural systems.

Task

In this task you will produce a presentation about biological control.

The presentation will be about 12 minutes long and it will have three sections.

Section 1 will be explaining predator–prey graphs and population changes.

Section 2 will be about predator–prey populations in the wild.

Section 3 will be about how humans use predators for biological control in agricultural systems.

Process

You will need to research predator–prey graphs and find out about how they are interpreted, find an example of one, and clearly explain the reasons why the numbers of each organism oscillate.

You will also need to explain why the populations peak at different numbers in different seasons and explain the term carrying capacity.

You should also research named examples of predator–prey relationships between populations in nature, with clear illustrations and example graphs or data.

Finally, you should research examples of biological control being applied to control pests in agriculture systems, and consider the costs and benefits of this compared with the use of pesticides.

Once the information has been collected, produce a PowerPoint to show your information.

Use a large, clear type font so that the slides can be read from the back of the room. Avoid large chunks of text and use short bullet points instead. Choose some clear illustrations to show the principles clearly.

Sources

Predator and prey populations

Useful introduction with a nice animation as an explanation.

<https://www.bbc.co.uk/bitesize/guides/zpw3jty/revision/1>

Trophic Links: Predation and Parasitism

A more complex explanation of the predator–prey graphs. Includes keystone predators.

<https://globalchange.umich.edu/globalchange1/current/lectures/predation/predation.html>

Population size

Includes an explanation of carrying capacity. Has a thought-provoking quiz at the end.

<https://people.wou.edu/~courtna/ch371/lecture/popgrowth/carrying.htm>

Biological control

A resource about biological control from Cornell University.

<https://biocontrol.entomology.cornell.edu/index.php>

Biological Control of Insect Pests

Article with examples of biological control.

<https://www.rhs.org.uk/advice/profile?pid=506>

Lynx–Snowshoe Hare Cycle

Describes a classic example of a wild predator–prey relationship.

<https://www.ealt.ca/blog/hare-vs-lynx-cycle>

Examples of Predator–Prey Relationships

Describes a range of wild examples.

<https://animalsake.com/examples-of-predator-prey-relationships>

Advantages & Disadvantages of Biological Control

Summary article with clear descriptions of advantages and disadvantages.

<https://owlcation.com/stem/Advantages-Disadvantages-of-Biological-Control>

Pest Control Tactics

Article with examples of biological control of pests.

<https://projects.ncsu.edu/cals/course/ent425/text19/biocontrol.html>

Conclusion

After completing the task, you should write a short summary for your notes.

You need to be able to clearly explain predator–prey graphs and why the populations fluctuate as they do.