18 Biodiversity, classification, and conservation

18.1 Biodiversity

Biodiversity is much more than a list of all the species in a particular area.

a) Species, ecosystem, and niches

- ➢ **species** – a species is a group of organisms with similar morphology and physiology, which can breed together to produce fertile offspring and are reproductively isolated from other species
- ➢ **ecosystem** – an ecosystem is a relatively self-contained, interacting community of organisms, and the environment in which they live and with which they interact
- **habitat** – a habitat describes the place where a species lives within an ecosystem
- ➢ **niche** – a niche is the role of an organism in an ecosystem

b) Biodiversity

- **biodiversity** – the degree of variation of life forms in an ecosystem

Biodiversity is considered at three levels –

a) **variation in ecosystems or habitats**
b) **the number of species and their relative abundance (species diversity)**
c) **genetic variation within each species**

a) variation in ecosystems or habitats

Some ecosystems are dominated by one or two species and other species may be rare. This is true in the case of natural pine forests in Florida and temperate forests in Canada which are dominated by a few tree species.

Other areas might have much higher biodiversity, such as coral reefs. It offers many different ecological niches, which are exploited by many different species.

b) the number of species and their relative abundance

This is also known as species diversity.

Species diversity takes species richness into account, but also includes a measure of the evenness of the abundance of different species

- the more species there are and the more evenly the number of organisms is distributed among the different species, the greater the species diversity
- ecosystems with high species diversity are more stable and able to resist changes
- the tropics are important centres for diversity (living conditions not extreme, high light intensity all year, animals don't have to expend energy keeping warm)

c) genetic diversity

Genetic diversity is the diversity of alleles within the genes in the genome of a single species.

How genetic diversity within a species can be assessed

By finding out –

1) what proportion of genes have different alleles?
2) how many alleles are there are per gene?

c) Sampling

There are two types of sampling – random sampling and systematic sampling.

a) Random sampling

This is a sample that fairly represents a population because each member has an equal chance of inclusion.

When should random sampling be used?

1) when an area looks reasonably uniform
2) no clear pattern to the way the species is distributed

*samples must be taken randomly to avoid bias

b) Systematic sampling

Systematic sampling is used investigate species distribution where physical conditions change e.g., altitude, soil moisture content, soil pH, light exposure/ intensity.

Methods of systematic sampling

1) **line transects**
2) **belt transects**

d) Methods to assess the distribution and abundance of organisms in a local area

METHOD	TYPE
1) frame quadrats	random
2) mark-release-recapture	random
3) line transects	systematic
4) belt transects	systematic

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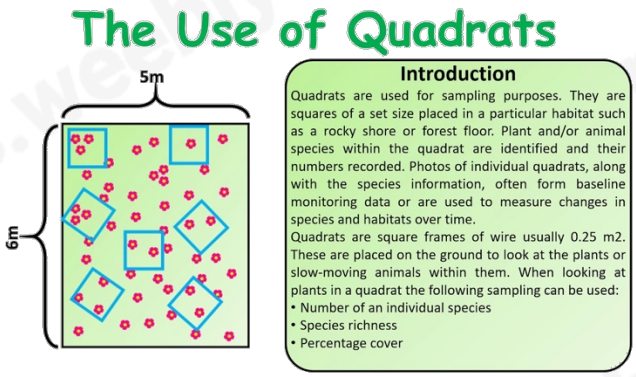
When assessing the distribution and abundance of organisms, the following can be used when recording species for accuracy –

1) dichotomous key
2) drawings or photographs with identification
3) timed research throughout the area being studied
4) if the species is unidentified, photograph and label them as 'species A', 'species B', etc.

1) Frame quadrats

A frame quadrat is a square frame divided into a grid of 100 smaller squares. Each small square is 1x1m.



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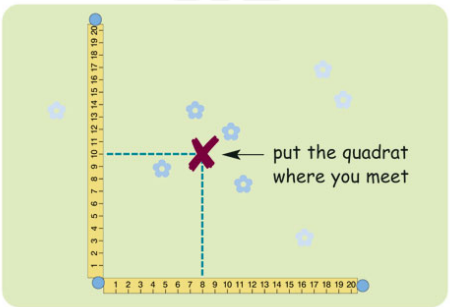
How to use a quadrat

1) measure area and form a grid
2) take 2 random numbers and use these as coordinates on your grid



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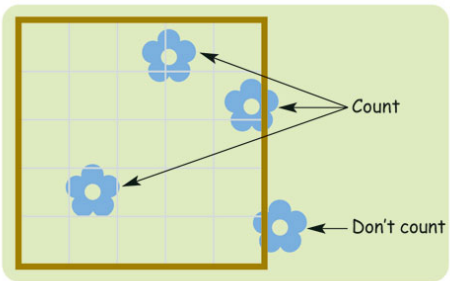
3) lay your quadrat down
4) count the number of species and record results
5) repeat the process again in different parts of the area



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6) ensure that –
   - there is random assignment of grids
   - the bigger the sample, the better (the validity)
7) limitations –
   - it will be hard to count fast moving animals, this method is limited to vegetation and slow-moving or stationary animals
   - the quadrat must also be placed on a fairly flat piece of land

The results of this can be used to calculate –

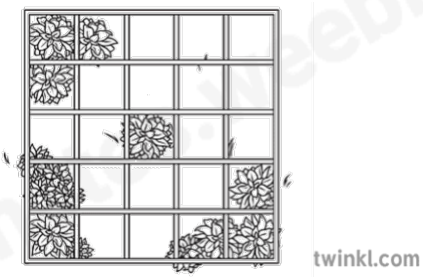
a) **species frequency** – measure of a chance of a particular species being found within any one quadrat

$$\text{Percentage frequency} = \frac{\text{Total number of quadrats in which species occured}}{\text{Total number of quadrats studied}} \times 100$$

b) **species density** – measure of how many individuals there are per unit area e.g., per square metre

$$\text{Population density} = \frac{\text{Total number of individuals in all the quadrats studied}}{\text{Total number of quadrats studied}} \times 100$$

c) **percentage cover** – the percentage area inside the quadrat that is occupied by each species



- if you have 100 little squares in 1 quadrat, then you count the squares in which the plant species is present – you count a square only when it is half or more covered by the plant
- so, if the plant is in about 25 squares within the quadrat you can say the plant covers 25% of the area
- not always equal to 100%; can be less or more

2) Mark-release-recapture

This is a method of estimating the population size of mobile organisms.

1) as many individuals as possible are caught
2) each individual is marked, in a way that will not affect its future chance of survival (e.g., cutting its fur)
3) marked individuals are counted
4) marked individuals are returned to their habitats to mix randomly with their population
5) after enough time has elapsed a large sample is recaptured
6) number of marked and unmarked individuals are counted

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7) the population size can then be estimated using –

$$\text{Total population size} = \frac{\text{Number caught in 1st sample} \times \text{Number caught in 2nd sample}}{\text{Number marked in 2nd sample}}$$

Precautions that should be taken to ensure that the results obtained from the mark-release-recapture method are valid.

1) sample from a large area

2) ensure there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture

3) the marking technique must not be toxic

4) the marking technique must not increase/decrease chances of survival

5) marking technique must not fall off / be rubbed off the animal

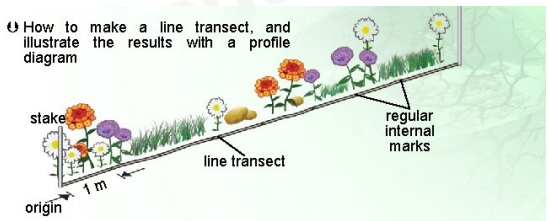
6) time is not so long that migration / life cycle changes have occurred

Transect sampling

a) **line transect (continuous)** – all individuals touching the line are recorded

b) **belt transect (can be continuous or interrupted)** – all individuals within the quadrats placed in the locations are recorded

3) Line transect



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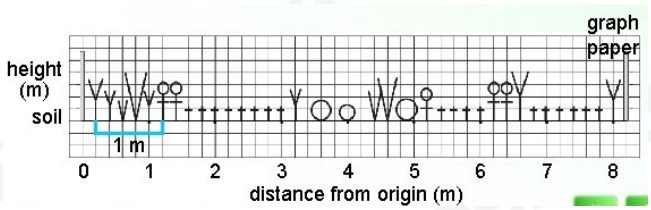
8) randomly select a starting point in the habitat being examined

9) unroll the transect line (a measuring tape can be used) along the gradient identified

10) the species touching the line may be sampled along the whole length of the line, which is called a transect (continuous sampling)

11) to sample, record the identity of the organisms that touch the line

12) a line transect will give qualitative data that is represented as a drawing



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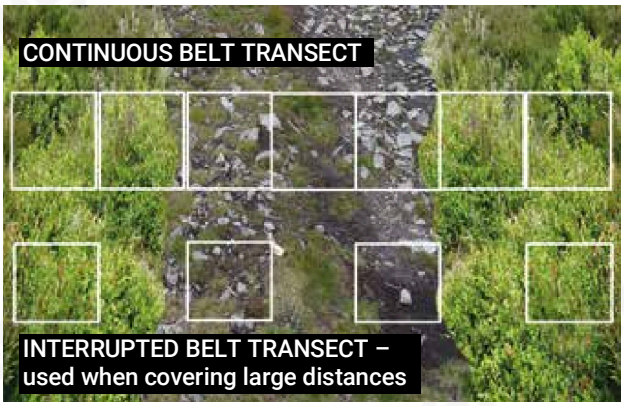
4) Belt transect



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1) extend a measuring tape from one side of the habitat to another

2) place a quadrat at 0m on the tape

3) count the numbers/estimate percentage cover of each species

4) use a key to identify each species

5) record results in a table

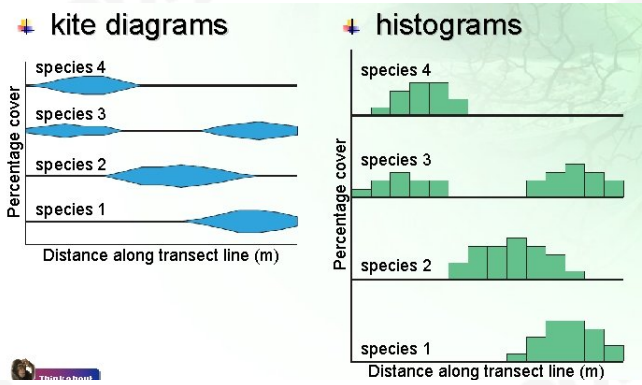
6) move the quadrat along the measuring tape

7) repeat step 3-5, this can be done via two different methods
   - interrupted sampling – repeat steps 3-5 in regular intervals e.g., recording the organisms present at every 2m
   - continuous – repeat steps 3-5 throughout the whole length of the measuring tape, recording all organisms in this distance

8) continue until the full length of the measuring tape has been sampled

9) calculate the average of each species

10) a bar chart, kite diagram or a histogram can be drawn to show the data obtained



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e) Spearman's rank correlation and Pearson's linear correlation

These are both used to analyse the relationships between **the distribution and abundance of species** and **abiotic or biotic factors**.

The formula for these correlations will be provided in the exam.

Correlation

A measure of the extent to which two factors vary together, and thus of how well either factor predicts the other.

- plot a scatter graph or calculate correlation coefficient (Pearson's correlation coefficient, denoted by *r*)
  - the correlation coefficient is measured on a scale that varies from +1 (positive correlation) through 0 to -1 (negative correlation)

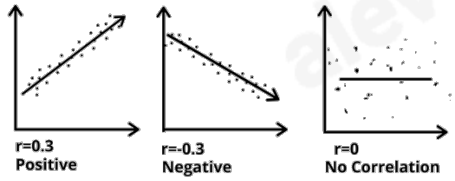

Image: https://www.c-sharpcorner.com/article/how-to-get-correlation-coefficient-in-power-bi/

- strength of correlation = how close the points are to the straight line

1) Spearman's rank correlation

Spearman's rank correlation determines whether there is correlation between variables that don't show a normal distribution.

$$r_s = 1 - \left(\frac{6 \times \Sigma D^2}{n^3 - n}\right)$$

Where:

- r_s is Spearman's rank coefficient
- ΣD^2 is the sum of the differences between the ranks of the two samples
- n is the number of samples

Use when –

1) data points are independent of each other
2) data is correlated, but not linear *(draw scatter diagram first)*

There are three steps to take when using the Spearman's rank correlation test –

1) **state the null hypothesis**

   "there is no correlation between ___ and ___"

2) **calculate the Spearman's rank correlation coefficient**
3) **test the significance of the result**
   - if the value calculated for r_s is greater than the critical value at p=0.05 (confidence level 95%), then the null hypothesis can be rejected, meaning there is a correlation between two variables
   - if r_s (ignoring any sign) is less than the critical value, accept the null hypothesis – there is no correlation between the two variables
   - the degree of freedom used is $(n-2)$ where n is the number of samples
   - a positive sign for r_s indicates a significant positive relationship and a negative sign indicates a significant negative relationship

2) Pearson's linear correlation

Pearson's linear correlation is a statistical test that determines whether there is linear correlation between two variables

Data must be quantitative and show normal distribution.

$$r = \frac{\Sigma xy - n\,\bar{x}\,\bar{y}}{n\,s_x s_y}$$

Where:

- r is the correlation coefficient
- x is the number of species A
- y is the number of species B
- n is the number of readings
- $\bar{x}$ is the mean number of species A
- $\bar{y}$ is the mean number of species B
- s_x is the standard deviation of the numbers of A
- s_y is the standard deviation of the numbers of B

Steps when using Pearson's linear correlation test –

4) **state the null hypothesis**

   "there is no correlation between ___ and ___"

5) **calculate the Pearson's linear correlation coefficient**
6) **test the significance of the result**
   - if r is close to 1 or -1, then it can be stated that there is a strong linear correlation between the two variables and the null hypothesis can be rejected

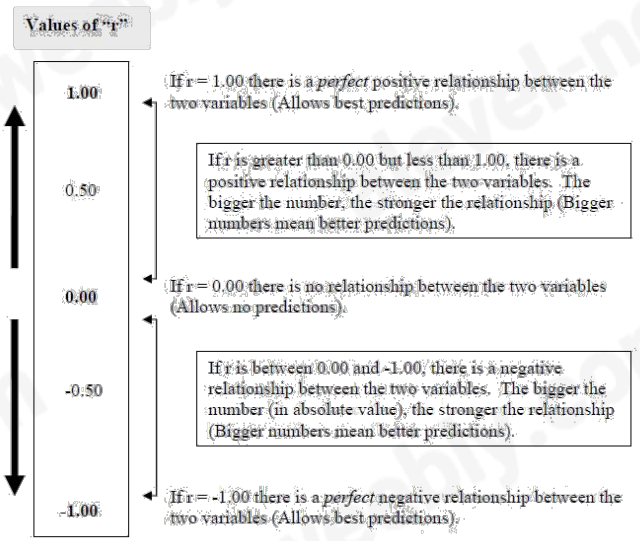

Image: https://www.biologyforlife.com/pearson-correlation.html

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- to see if the relationship found in a sample is significant, see if the value of r is greater than the critical value at p=0.05
- the degree of freedom used is $(n-2)$ where n is the number of readings

f) Simpson's Index of Diversity (*D*)

A measure of biodiversity between 0 and 1 that takes into account both species richness and species evenness.

- used to quantify the biodiversity of an area
- as species richness and evenness increase, biodiversity increases
- values near 1 indicate high levels of biodiversity
- values near 0 indicate low levels of biodiversity

$$D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$$

Where:

- n is the total number of organisms of one species
- N is the total number of organisms of all species

18.2 Classification

a) Hierarchy of taxa

- taxonomy is the science involved with classifying groups of organisms on the basis of shared characteristics
- organisms are grouped according to a series of hierarchical taxa – the more taxa organisms share, the more similar they are
- the taxa used are kindom → phylum → class → order → family → genus → species (genus + species = scientific name)

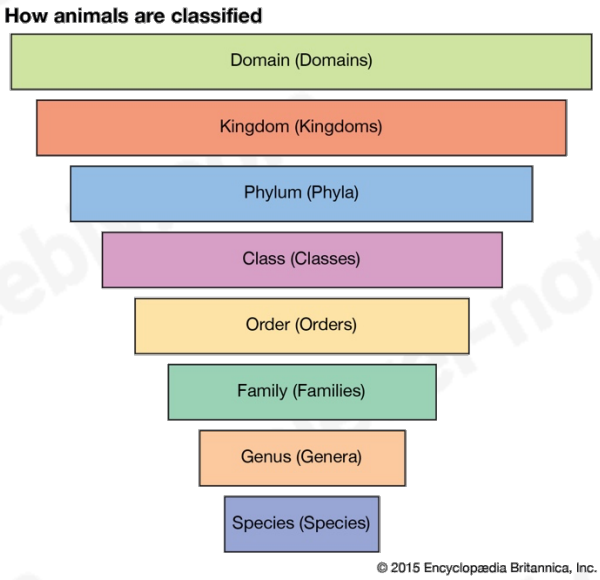

Image: https://www.britannica.com/science/taxonomy/A-classification-of-living-organisms

b) The three domains of life

- the domain is at the top of the hierarchical system of which organisms are classified
- there are three domains – **b**acteria, **a**rchaea and **e**ukarya *(protists, fungi, plants, and animals)*
- of these three domains, two (bacteria and archaea) consist of prokaryotic organisms, and eukarya consists of eukeryotes
- the mnemonic "**BAE**" can be used to remember this

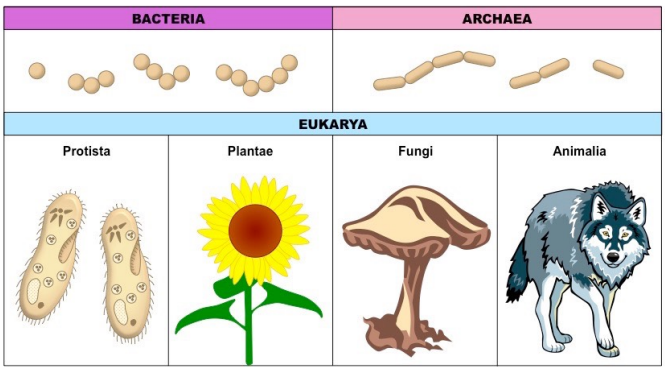

Image: https://ib.bioninja.com.au/

a) Characteristic features of bacteria

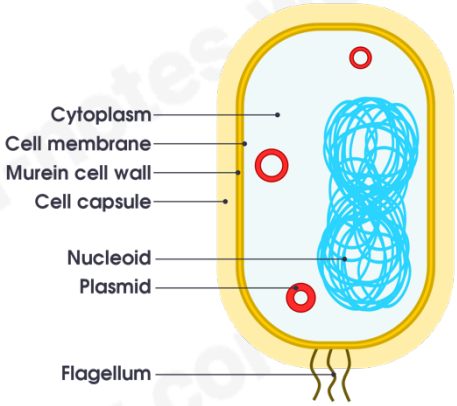

Image: https://commons.wikimedia.org/

1) unicellular prokaryotes
2) DNA exists as a circular 'chromosome' and does not have histone proteins associated with it
3) smaller circular molecules of DNA called plasmids are often present
4) no membrane-bound organelles are present
5) ribosomes (70 S) are smaller than in eukaryotic cells
6) cell wall is always present and contains peptidoglycans (not cellulose)
7) cells divide by binary fission, not by mitosis
8) usually exist as single cells or small groups of cells.

b) Characteristic features of archaea

1) unicellular prokaryotes
2) similar size range as bacteria
3) no membrane-bound organelles

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4) DNA exists as a circular 'chromosome' and does have histone proteins associated with it
5) ribosomes (70S) are smaller than in eukaryotic cells, but they have features that are similar to those in eukaryotic ribosomes, not to bacterial ribosomes
7) smaller circular molecules of DNA called plasmids are often present
8) cell wall always present, but does not contain peptidoglycans
9) cells divide by binary fission, not by mitosis
10) usually exist as single cells or small groups of cells

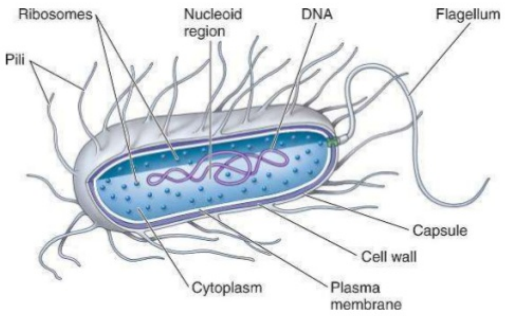


Image: https://www.slideshare.net/MariyaRaju/the-archaea

c) Characteristic features of eukarya

1) all organisms classified have cells with nuclei and membrane-bound organelles
2) DNA in the nucleus arranged as linear chromosomes with histone proteins
3) ribosomes (80S) in the cytosol are larger than in prokaryotes; chloroplasts and mitochondria have 70S ribosomes, like those in prokaryotes
4) chloroplast and mitochondrial DNA is circular as in prokaryotes
5) a great diversity of forms: there are unicellular, colonial, and multicellular organisms
6) cell division is by mitosis
7) many different ways of reproducing - asexually and sexually

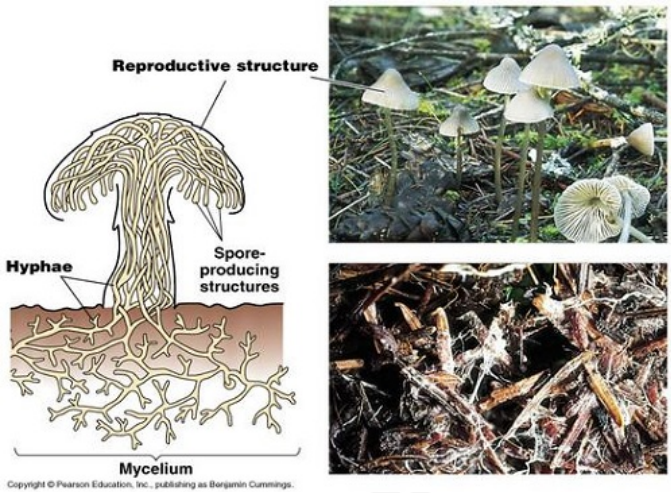
c) Kingdoms

a) Characteristic features of the kingdom Protoctista

1) encompasses all eukaryotic cells that do not belong to the other three eukaryotic kingdoms
2) some are protozoa: have animal-like cells (no cell walls)
3) some are algae: have plant-like cells (cellulose cell wall and chloroplasts)

b) Characteristic features of the kingdom Fungi

1) heterotrophic (obtain energy and carbon from dead and decaying matter or by feed as parasites on living organisms)
2) none contain chlorophyll so does not photosynthesise
3) reproduce by means of spores
4) cells have cell walls made of chitin or other substances, not cellulose
5) never have cilia or flagella
6) simple body form, which may be unicellular or made up of long threads called hyphae (mycelium) and large fungi such as mushrooms produce large, compacted masses of hyphae known as 'fruiting bodies' to release spores



c) Characteristic features of the kingdom Plantae

1) multicellular eukaryotes with cells that are differentiated to form tissues and organs
2) few types of specialised cells
3) some cells have chloroplasts and photosynthesise
4) cells have large, often permanent vacuoles for support
5) autotrophic nutrition
6) cell walls are always present and are made of cellulose
7) cells may occasionally have flagella - e.g., male gametes in ferns
8) complex body forms with branching systems above and below the ground

d) Characteristic features of the kingdom Animalia

1) multicellular eukaryotes with many different types of specialised cells
2) cells that are differentiated to form tissues and organs
3) cells do not have chloroplasts and cannot photosynthesise (although some, such as coral polyps have photosynthetic protoctists living within their tissues)
4) cell vacuoles are small and temporary (for example, lysosomes and food vacuoles)
5) heterotrophic nutrition

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6) cells do not have cell walls
7) communication is by the nervous system
8) cells sometimes have cilia or flagella

d) Viruses

Characteristics of viruses

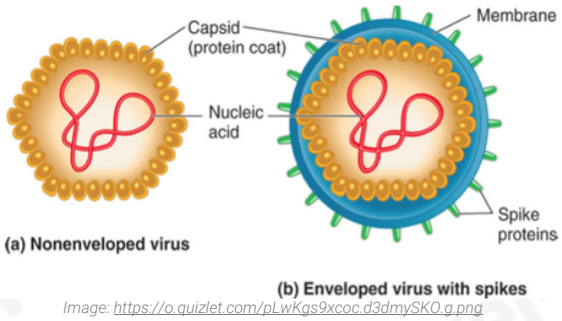

Image: https://o.quizlet.com/pLwKgs9xcoc.d3dmySK0.g.png

1) acellular (no cellular structure or metabolism)
2) can only be seen using an electron microscope
3) hijack the DNA replication machinery in host cells to make proteins and replicate
4) energy need for such processes is provided by respiration in the host cell

How viruses are classified

Viruses are not included in the three-domain classification system as they have none of the features that are traditionally used for classification.

Instead, the taxonomic system for classifying viruses is based on –

1) the diseases which they cause
2) the type of nucleic acid they contain (DNA or RNA)
3) whether the nucleic acid is single stranded or double stranded
   - in humans, DNA is always double stranded, and RNA is always single stranded
   - however, in viruses, DNA and RNA can be either single stranded or double stranded

Viruses, therefore, are classified into four groups:

NUCLEIC ACID	NO. OF STRANDS	EXAMPLE	DISEASE
DNA	1	canine parvovirus type 2	canine parvovirus
	2	varicella zoster virus (VZV)	chickenpox
RNA	1	morbillivirus	measles
	2	human immunodeficiency virus	HIV/AIDS

18.3 Conservation

a) Threats to biodiversity

- **habitat loss** – the destruction of the natural environment
- **habitat fragmentation** – many species of plant and animal either lose their habitats completely or their habitats become divided into small areas
- **species at most risk of extinction** – endemic species on small islands
- **keystone species** – a species that influences the survival of many other species in an ecosystem

There are five major threats to biodiversity:

1) habitat loss and the degradation of the environment
2) climate change
3) excessive use of fertilisers and industrial and domestic forms of pollution
4) the overexploitation and unsustainable use of resources
5) the effects of invasive alien species on native species, especially endemics

Threats to the biodiversity of aquatic ecosystems

1) overfishing (very difficult to know whether fish stocks are sustainable), example of overexploitation of resources
2) fishing further down the food chain taking smaller fish that other animals depend on influences their populations too
3) non-biodegradable plastic is a major marine pollutant
4) fertilisers that have not been absorbed by crop plants drain into aquatic ecosystems causing the overgrowth of producers such as algae faster than herbivores can feed on them
5) algae producing toxic substances and affecting coral reefs
6) acidification of marine ecosystems due to acid rain reducing the biodiversity as few animals are able to survive/breed in waters of low pH
7) coral bleaching due to increase in water temperature due to increase in greenhouse gases

Threats to the biodiversity of terrestrial ecosystems

1) global warming (cattle and rice farming, breakdown of organic waste in landfills under anaerobic conditions increasing methane emissions) is likely to produce changes in the distribution of terrestrial ecosystems
2) when organisms migrate to cooler areas, competition would occur between migrating organisms and species in existing communities

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3) some ecosystems will become even more restricted in their range due to global warming causing problems for coastal ecosystems

b) Why biodiversity needs to be maintained

REASON	EXPLANATION
moral and ethical	1) humans share the planet with millions of other species, and they have no right to cause the extinction of other species 2) humans also have a responsibility to reduce their impact on the planet and other species
ecological	1) the higher the diversity of an ecosystem, the less likely it is to be unbalanced by changes in conditions or threats such as pollution 2) ecosystems are of direct value to humans; many of the drugs that we use originate from living organisms
environmental	organisms provide essential environmental services e.g., the water cycle, nutrient cycle, and absorption of CO_2
social and commercial	1) a range of organisms contribute to medicine, ecotourism, science, and technology 2) microorganisms are a source of useful products e.g., *Taq* polymerase used for PCR in forensic and DNA analysis
aesthetic	1) humans take pleasure from the visual effects of biodiversity 2) wildlife is a source of income for many countries as ecotourism has increased in popularity; this form of tourism provides employment and contributes to the economies of these nations
agricultural	genetically diverse wild species can rescue cultivated crops from catastrophes such as disease

c) Methods of protecting endangered animals

- Endangered species – an endangered species is one that is threatened with extinction

Summary of conservation methods

CONSERVATION METHOD	ROLE
zoos	• captive breeding programmes for the reintroduction of animal species into the wild • research • education
botanic gardens	• captive breeding programmes for the reintroduction of plant species into the wild
national parks	• protecting endangered animal and plant species through strict regulations • increasing public engagement in conservation
marine parks	• protecting endangered animal and plant species through restrictions • increasing awareness
'frozen' zoos	• long term storage of animal genetic material at very low temperatures
seed banks	• long term storage of plant seeds in a temperature-controlled environment

a) Zoos

1) provide enjoyment and interest for visitors
2) provide protection for endangered and vulnerable species
3) have had success with captive breeding programmes, often with the long-term aim of reintroducing the animals to their natural habitat
4) contribute to research (trying to gain a better understanding of breeding habits, habitat requirements and ways to increase genetic diversity)

Problems associated with captive breeding programmes

The major goal of captive breeding is to reintroduce animals to their natural habitat.

1) inbreeding due to small population size
2) some animals simply refuse to breed in captivity
3) often it is not possible to create suitable habitats for animals so they cannot be returned to the wild
4) some captive-bred animals do not know how to avoid predators, find food, or rear their own young

b) Botanic gardens

Seeds or cuttings are collected from species in the wild and then used to build up a population of plants from which, one day, some plants may be reintroduced to their natural habitats.

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1) protect endangered plant species
2) research methods of reproduction and growth
3) research conservation methods
4) reintroduce species to habitats
5) educate the public (roles of plants in the ecosystem, economic value, etc.)

How a sample of cells could be grown on agar

**Carried out in sterile conditions*

1) cells divide by mitosis to give a mass of cells that can be cloned by subdividing them
2) when the cells are transferred to a medium containing an appropriate mixture of plant hormones, they grow stems and roots and can then be transferred to grow in soil
3) these techniques of tissue culture and cloning are used to produce large numbers of plants from a few original specimens

c) Conserved areas (national parks and marine parks)

National parks

- areas within countries where the wildlife and environment are protected
- governments control these areas and pass legislation to ensure their protection
- there are several restrictions –
  - human access is strictly controlled
  - industrial activities such as agriculture and building are highly regulated
  - hunting is limited or completely prohibited

Marine parks

- protected areas of water that have been set up for the conservation of endangered marine ecosystems and species
- they also have restrictions to prevent overfishing and population

The aim of such conserved areas is to increase public engagement.

- national and marine parks attract lots of tourists which increases money and awareness for the conservation effort
- involving members of the local community in the management of protected areas can provide jobs and increase acceptance of the parks
- some of the profits made from the parks can be used to improve health and education standards in the nearby communities to illustrate the benefits of having such areas nearby

d) 'Frozen' zoos

Holds genetic resources for endangered species in the form of eggs, sperms, and embryos until they're needed.

- holds more genetic diversity than a normal zoo
- genetic material is kept for longer periods of time

Eggs are more difficult to freeze as they are more likely damaged by freezing and thawing (ice crystals may form which damage internal membranes).

e) Seed banks

Seeds of the same species are collected from different sites, so that the stored samples contain a good proportion of the total gene pool of that species so genetic diversity is not lost.

- seeds can be stored for a long time with little maintenance, anywhere in the world
- seeds are germinated every few years to:
  1) check if seeds are still viable produce new plants to collect new seeds
  2) find conditions for breaking seed dormancy

Ways to keep the genetic diversity of species with recalcitrant seeds

These are seeds cannot be dried and frozen, such as seeds of economically important tropical species e.g., rubber, coffee, cocoa.

1) collect seeds and grow successive generations of plants
2) keep as tissue culture

d) Assisted reproduction

Assisted reproduction refers to medical and scientific methods used to help conceive.

Why assisted reproduction is useful

1) it's a solution to the problem of inbreeding
2) solve the problem of males and females who do not show any courtship behaviour and will not mate
3) movement of large mammals is difficult, expensive, and breeding does not always happen so sperm is collected which can then be used in assisted reproduction

Sperm bank

A storage facility that holds supplies of semen that's frozen for future use

- samples are collected from males, checked for sperm activity, and then diluted with a medium containing a buffer solution and albumen
- small volumes of semen are put into straws (thin tubes) and are stored in liquid nitrogen at -196°C

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There are several methods of assisted reproduction –

a) in vitro fertilization (IVF)
b) artificial insemination (AI)
c) embryo transfer
d) surrogacy

a) In vitro fertilization (IVF)

1) oocytes are collected by inserting a needle into the ovaries and withdrawing some mature follicles
2) the oocytes are kept in a culture medium for a short time and then mixed with semen
3) the resulting zygotes divide to form embryos, which are cultured for several days and then placed into the mother or into several females of the same or different species
4) these embryos can also be stored in 'frozen zoos'

b) Artificial insemination (AI)

A straw is placed into warm water so that sperm become active and then put into a catheter, which is inserted into the vagina, through the cervix and into the uterus.

- may happen when the female is naturally ovulating or may follow hormone treatment, so she super ovulates to produce a large number of follicles at the time of AI
- following AI, the resulting embryos may be 'flushed out' of the uterus and transferred to other females (surrogate mothers) that have had hormonal treatment to prepare them for pregnancy
- protects endangered animals from pregnancy
- the endangered female becomes the source of many offspring

e) Preventing overpopulation

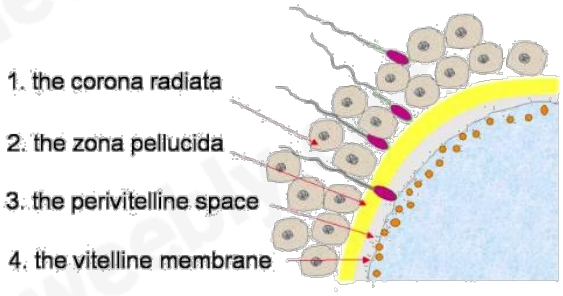
- organisms that have been saved from extinction has increased in numbers beyond the capacity of the ecosystem to sustain such numbers
- therefore, **culling** is used to reduce numbers

➢ **culling** – reduction of an animal population by selective slaughter

There are a few methods of culling –

1) transferring animals to places where there are small populations
   - expensive and not easy over large distances)

2) birth control
- sedating male wild mammals and cutting their sperm ducts (vasectomy)
- chemical contraceptives –
  - vaccine is used which targets the zona pellucida
  - the zona pellucida is the region surrounding the layer of glycoproteins around an egg cell



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  - this stimulates an immune response that produces antibodies against these glycoproteins
  - the antibodies attach to the glycoproteins around the female's own eggs, so blocking sperm from fertilising the egg *(90% success rate)*

f) Alien species

Alien or invasive species are those that have moved from one ecosystem to another where they were previously unknown.

Causes of alien species

1) humans trading animals and plants or unwittingly carrying them on ships
2) introduced as biological control agents to control pests
3) escapees
4) animals introduced for sport

Effects of alien species

1) successful predators with few controls (no natural predators of it in new environments)
2) may compete effectively with native organisms that occupy the same niche, pushing them to extinction
3) may also introduce diseases that spread to similar organisms that have never been exposed to the pathogens
4) outcompete native species simply by reducing the space where they can grow

Examples of alien species

a) Red lionfish (Pterois volitans)

- native to the seas of South-East Asia
- invading the waters of the Caribbean (likely to have escaped from aquaria in the US)
- eating its way through many local species on coral reefs
- no natural predator in its new environment

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b) Water hyacinth (Eichhornia crassipes)

- a floating aquatic plant that spreads rapidly when introduced to new habitats
- blocks sunlight from reaching native aquatic plants and reduces the oxygen concentration of the water, so killing fish
- provides a habitat for mosquito larvae
- its control is important for the sake of human health

g) Roles of NGOs in local and global conservation

Non-governmental organisations involved in local and global conservation –

a) the World Wide Fund for Nature (WWF)
b) the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES (Convention on International Trade in Endangered Species)

A signed agreement to control trade of endangered species and their products e.g., fur, skin, ivory.

1) considers evidence presented to it about endangered species and assigns to 1 of 3 appendices with given criteria and trading regulations
2) sometimes CITES listings don't benefit the species: species trade becomes illegal, the price for products increases causing more trade occurs

WWF (World Wildlife Fund for Nature)

Largest and most well-known NGO for conservation.

1) funds conservation projects
2) publicises environmental issues
3) campaigns to save ecosystems from degradation and species from extinction

h) Restoring degraded habitats

1) small scale – farmer plants trees on land that is no longer needed for food production
2) e.g., mangrove forest is being replanted in many parts of the world to provide protection against storm damage, flooding, and rising sea levels
    - mangrove forests are also important nursery grounds for young fish

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