

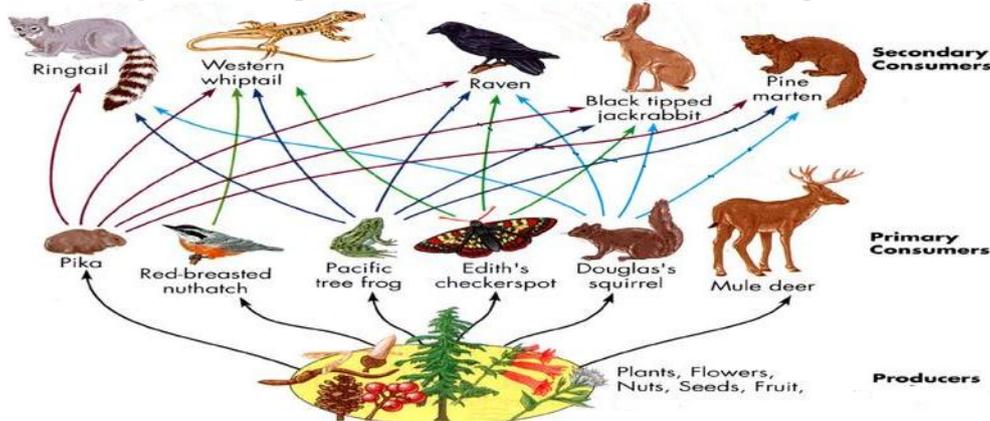
### **Topic 3 – Problems and solutions to a changing environment**

- **DRUGS**
- **What is a drug?**
- A drug is a chemical substance that changes the way in which the body works
- Some drugs particularly affect the central nervous system and change our behaviour – i.e the way we feel, think and act
- **Different types of drugs:**
- Drugs are grouped according to the effects they have on us...
- Narcotics:
  - Slow down neurotransmission across synapses → make us feel sleepy – reactions are slower
- Painkillers e.g morphine:
  - We feel pain when electrical impulses from a damaged area of the body are sent via neurones to the brain
  - Painkillers block some of these nerve impulses → we feel less pain
- Hallucinogens e.g LSD:
  - Hallucinogens make us see, hear and feel things that aren't actually there
- Stimulants e.g caffeine:
  - Increase the speed of neurotransmission across synapses → make us feel energetic and awake – reactions are faster
- Depressants e.g alcohol:
  - Depressants decrease the activity of neurones in the brain → can help us relax - reactions are slower
- Any drug that's used to make people feel a certain way is a recreational drug – e.g alcohol, LSD (i.e one that's not taken because of illness)
- Some drugs are medicines that help to limit damage caused by diseases or injuries
- **THE DAMAGE CAUSED BY SMOKING**
- **Damage caused by tar:**
- The sticky tar in cigarette smoke contains chemical substances called carcinogens
- These can cause cancers, most often in the lungs and mouth
- **Damage caused by carbon monoxide:**
- Oxygen binds to haemoglobin inside red blood cells, and is then transported round the body
- Carbon monoxide combines with haemoglobin, reducing the amount of oxygen red blood cells can carry → body cells receive less oxygen
- Carbon monoxide also makes blood vessels narrower (vasoconstriction), which further reduces the oxygen carrying capacity of the blood
- Carbon monoxide and other gases in tobacco smoke can also damage lung tissue – this causes respiratory diseases such as emphysema and chronic bronchitis
- **Nicotine:**
- it's the addictive part of tobacco smoke
- Nicotine acts on receptor sites in the brain → making you crave more of the drug
- **THE EFFECTS OF ALCOHOL**
- **Short-term effects of alcohol:**
- **1. Alcohol is a depressant → slows down activity of the brain → ...**
  - Slower reaction times

- →blurred vision and loss of coordination, making it more difficult to do simple physical or mental tasks (e.g driving)
- **2. Alcohol can also lower inhibitions...** i.e people will do things after drinking alcohol that they wouldn't normally do, including taking greater risks
- Very large amounts of alcohol can...:
  - Cause unconsciousness and possible death by choking on vomit
  - Slow the nervous system down so much that breathing stops
- **Long-term effects of alcohol:**
- **1. Cirrhosis of the liver**
  - Liver tissue is destroyed →liver can't function properly →can lead to death
- **2. Brain damage**
  - Affects learning and memory or can cause a blood clot in the brain
- **3. Alcoholism**
  - Alcohol can be addictive – people who become dependent on alcohol are called alcoholics
- **ETHICS AND TRANSPLANTS**
- In a transplant, a healthy organ such as a heart or liver is taken from one body (a donor) and put into a patient to replace an organ that no longer works properly
- There are not enough donor organs →doctors must decide which patients to operate on...
- **Scientific criteria - decisions based on the likelihood of success:**
- How similar are the tissues? The closer the match, the more likely the transplant will be successful
- Are they of a similar age? The closer the age of the donor organ is to that of the patient, the more likely the operation will be a success
- How geographically close is the donor organ to the patient? The quicker the organ is transplanted, the more likely the operation will be successful
- How ill is the patient? A very ill patient is less likely to survive an operation than a healthy one
- **Ethical criteria – decisions based on what is right and wrong:**
- Examples:
  - Should alcoholics be given liver transplants?
  - Should obese people be given heart transplants?
- Ethical decisions are hard because different people have different views on what is right and what is wrong...
  - E.g some people believe certain lifestyles that cause diseases (e.g alcohol addiction) are not the person's fault (i.e they are inherited traits or the result of unfortunate life events) →they should receive treatment like everyone else
  - Other people instead think lifestyle is a choice (i.e you can choose whether or not to drink) →shouldn't be allowed the same chance for treatment, especially as there is a shortage of donor organs
- **PATHOGENS AND INFECTION**
- **Pathogens and disease:**
- Diseases that are passed from an infected person to someone who is not infected are called 'infectious diseases'
- Infectious diseases are caused/spread by microorganisms called 'pathogens'
- There are several types of pathogens - viruses, bacteria, fungi and protoctists
- Different pathogens spread different diseases:

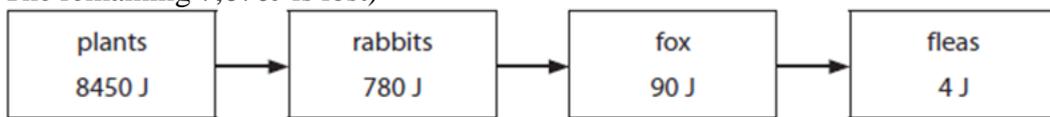
- Infectious diseases like cholera, food poisoning, dysentery and tuberculosis (TB) are caused by bacteria
- Infectious diseases like influenza (flu), mumps, measles and AIDS are caused by viruses
- Fungi cause athlete's foot
- Protozoan (a type of protist) causes malaria
- **How pathogens pass between people:**
- In contaminated water – e.g cholera
- Airborne (e.g by coughing) – influenza virus and TB
- By exchange of body fluids – e.g HIV
- By direct contact – e.g athlete's foot
- By food – e.g salmonella bacteria
- Sometimes pathogens pass from one person to another by animal vectors:
  - Mosquitoes – e.g anopheles mosquito can transfer protozoan into human blood → malaria
  - Houseflies – can carry dysentery bacteria from human faeces to food
- **ANTISEPTICS AND ANTIBIOTICS**
- **Defence against invasion:**
- Animals, including humans, have many different ways to protect themselves against attack from pathogens:
  - Physical barriers stop pathogens getting into the body:
    - Skin – forms a protective barrier
    - Mucus – traps microorganisms
    - Cilia – these are tiny hairs in the windpipe that sweep mucus and microorganisms trapped in it upwards so they can be coughed out
  - Chemical defences help kill pathogens before they can harm us:
    - Hydrochloric acid in the stomach kills harmful microorganisms in food
    - Tears (liquid is produced by tear glands) contain enzymes called lysozymes that kill microorganisms
- **Using antiseptics:**
- Chemical substances called antiseptics can kill pathogens outside the body:
  - E.g antiseptics can be applied to the surface of an open wound to help prevent pathogens getting into the wound and causing infection
- **Using antibiotics:**
- If pathogens enter the body (i.e they manage to pass through the body's physical barriers), we need a way of killing them without killing the patient
- Antibiotics are medicines that kill or prevent the growth of bacteria and some fungi...
  - Antibiotics that only affect bacteria are called antibacterials
  - Antibiotics that only affect fungi are called antifungals
- Antibiotics don't kill viruses → can't be used to treat diseases caused by viruses such as HIV (AIDS), influenza and mumps
- **Resistance:**
- Individual bacteria in a population show variation → some will be naturally more resistant to an antibiotic (i.e will be killed much more slowly)
- When an antibiotic is first taken, the less resistant bacteria are killed first, the more resistant survive

- If person stops taking antibiotic too early then the resistant bacteria will live to reproduce and pass on their resistant genes to their offspring → forming a new colony of resistant bacteria
- → over time, misuse of antibiotics (i.e stopping treatment early) can lead to resistant strains of bacteria – e.g MRSA is resistant to many antibiotics
- **INTERDEPENDENCE AND FOOD WEBS**
- **Food webs:**
- Some organisms are producers – these make their own food e.g green plants which use photosynthesis
- The rest get their food from other organisms...:
  - Primary consumers get their energy by eating plants → are herbivores
  - Secondary consumers get their energy by eating primary consumers → are carnivores
- Food chains show what eats what:
  - E.g red oat grass (producer) → zebra (primary consumer) → lion (secondary consumer)
  - I.e: zebras eat red oat grass. Lions eat zebras.
- Organisms that feed at the same level in a food chain are in the same trophic level:
  - Producers are at the first trophic level
  - Primary consumers are at the second trophic level
  - Secondary consumers are at the third trophic level
- Food chains from a habitat can be joined together into a food web, which shows the feeding relationships between the different organisms...e.g:

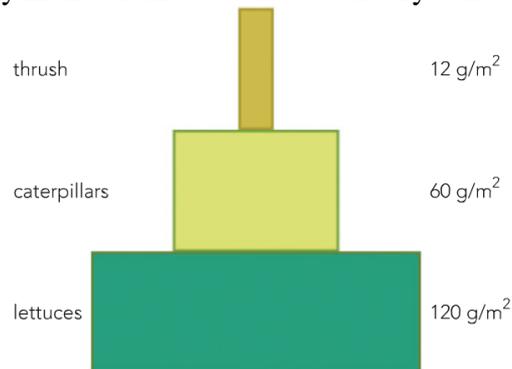


- Organisms in an area depend on each other for food – i.e they are interdependent
- As the numbers of one organism change, other organisms are affected...:
  - E.g when there's lots of prey, predators have more food → they increase in number
  - As predator number goes up, more prey are eaten → they decrease in number
- → the relationships between the organisms are always changing - this is called a dynamic relationship
- **Energy transfers in food chains:**
- Energy is stored inside each living organism as 'biomass' (the total mass of an organism)
- The energy stored in biomass is transferred to the next organism in the food chain when it's eaten. However, some of the energy is lost...

- E.g. of the 8,450J in plants, 780J is passed on to rabbits when they eat the plants. The remaining 7,670J is lost)



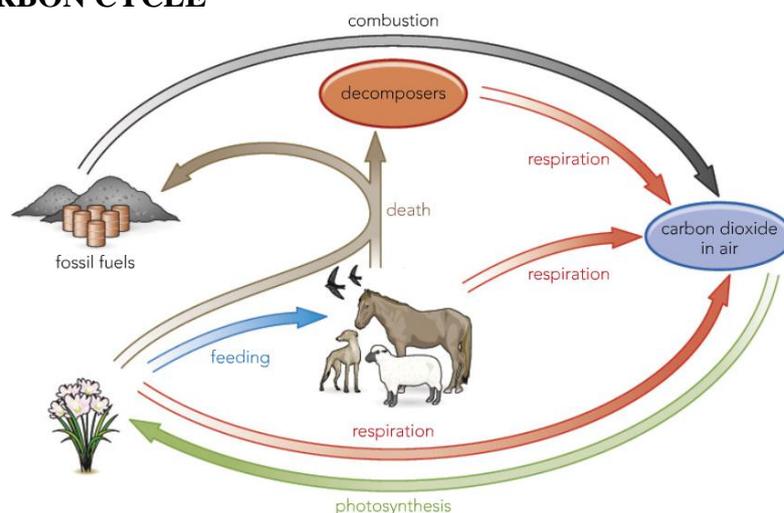
- So at each trophic level of a food chain, there is less and less energy to provide energy for another level - this limits the length of a food chain
- The less and less energy in the biomass at each trophic level is represented as a 'pyramid of biomass' ... i.e:
  - Lots of energy in the biomass at the producer stage... → wide base
  - Little energy in the biomass at the secondary consumer level... → pointy top



- Energy in biomass can be lost between trophic levels as a result of...
  - Respiration
  - Excretion
  - Regulation of body temperature (energy is lost as heat)
  - Movement/exercise
  - Not all of the organism being eaten
- **PARASITES AND MUTUALISTS**
- In most feeding relationships, a predator kills and eats its prey and then moves to find more prey. But not all feeding relationships are like this...
- **Parasitism:**
- Parasitism is a feeding relationship in which two organisms live together, with one feeding off (and benefiting from) the other:
  - The organism doing the feeding is called the parasite
  - The organism which the parasite feeds on is called the host
- Parasites are usually harmful to their hosts...
- Examples of parasites:
  - Headlice and fleas – live outside their host, feeding off their blood
  - Tapeworms – live inside vertebrate intestines. Absorb nutrients from the host's gut → can cause the host to lose a lot of weight
  - Mistletoe – grows its roots into the veins of the host tree → can absorb water and mineral salts from it
- **Mutualism:**
- In some relationships, both organisms benefit – this is called mutualism
- E.g in Africa, oxpeckers eat parasitic insects (e.g fleas) that live on the skin of large herbivores:
  - So oxpeckers feed themselves, and at the same time remove fleas from herbivores... → both organisms benefit

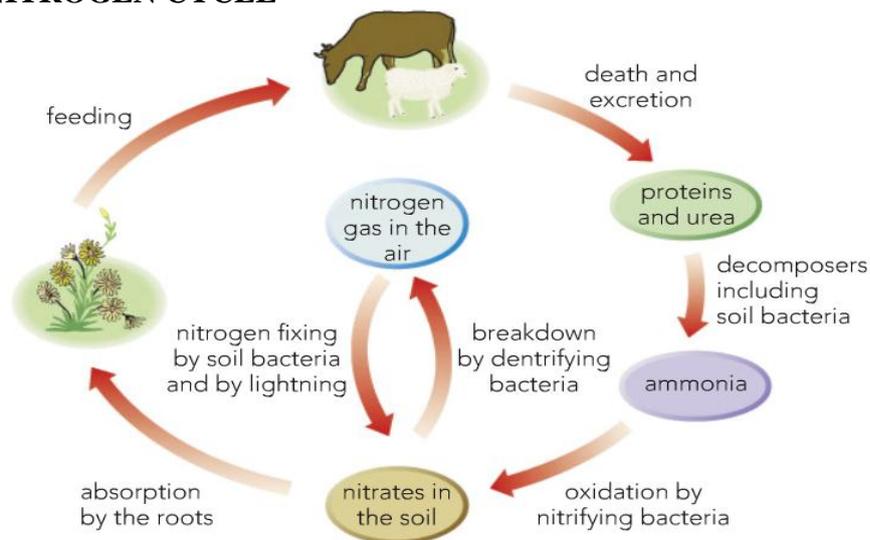
- E.g 2 cleaner fish eat dead skin and parasites from the skin of larger fish, such as sharks... →both organisms benefit
- **Some organisms live in mutualistic relationships inside other organisms:**
- E.g1 nitrogen-fixing bacteria live inside legumes:
  - Nitrogen-fixing bacteria turn nitrogen in the air into nitrogen compounds
    - The bacteria are protected from the environment and obtain chemical substances from the plant that they use as food
    - The plant gets nitrogen compounds (nitrates) from the bacteria, which it uses for growth
    - →both the bacteria and the plant benefit from the relationship
- E.g2 chemosynthetic bacteria live in the gut of giant tubeworms:
  - Tubeworms provide a place for bacteria to live, and offer protection
  - Bacteria convert sulfur compounds into food that tapeworms can eat
  - →both tubeworms and bacteria benefit from the relationship
- **POLLUTION**
- The World's human population is growing rapidly
- The increase in the world's population has contributed to an increase in the production of both air and water pollutants...
- **Air pollution**
- 1. Sulfur dioxide gas released from the burning of fossil fuels causes acid rain
- 2. Carbon dioxide gas also released by the burning of fossil fuels (and deforestation) causes climate change (global warming)
- **Water pollution:**
- Increased use of fertiliser:
  - Fertilisers contain nitrates and phosphates – both nutrients needed by plants to grow well
  - →farmers add fertiliser to crops to help them grow better
  - However, if too much fertiliser is used, it can get into water and raise the natural concentration of nitrates and phosphates – this is called eutrophication
- **The process of eutrophication:**
  1. Fertiliser is added to crops
  2. Heavy rain washes fertiliser off
  3. Nitrates and phosphates contained within fertiliser are washed into streams or rivers
  4. This encourages number of algae in water to increase ('algal bloom')
  5. These surface plants block sunlight...(sunlight is needed for photosynthesis) ... →plants in the water die and stop producing oxygen through photosynthesis
  6. Bacteria, which decompose dead plants in the water, reproduce quickly (i.e increase in number quickly) →use up more and more oxygen for respiration
  7. So oxygen concentration in the water decreases →fish in water die due to a lack of oxygen
- **POLLUTION INDICATORS**
- Some organisms are very sensitive to polluting chemicals →they can be used to help show us the presence of pollution – these are called indicator species
- **Air pollution indicators:**
- E.g blackspot fungus that infects roses is killed by sulfur dioxide pollution in the air (→presence of blackspot on roses shows the air is clean)
- E.g2 lichens:

- Different species of lichen can tolerate different amounts of sulfur dioxide and other polluting gases such as nitrogen oxides
- →lichens can be used to indicate the presence of these gases in the air
- **Water pollution indicators:**
- Different animals that live in water need varying amounts of oxygen...:
  - Stonefly larvae and freshwater shrimps need lots of oxygen→they are clean water indicators (i.e if there's lots of them it indicates that the water is clean there)
  - Bloodworms and sludgeworms are adapted to live where there's little oxygen in the water→are polluted water indicators (i.e if there's lots of them it suggests the water is very polluted there)
- **The importance of recycling:**
- Tonnes of waste is produced every year, much of it ending up buried in the ground in landfill sites
- Problems with landfill sites:
  - Use up a lot of land
  - Risk of pollution
  - Materials can't be used again (this is a problem because we are running out of some raw materials completely e.g zinc)
- Recycling is the process of taking materials out of waste before disposal and converting them into new products we can use
- →recycling can reduce demand for resources and the reduce the problem of waste disposal
- E.g of materials that can be recycled:
  - Metals in drinks cans can be melted down and recycled as new drinks cans or part of a car
  - Paper can be recycled as more paper or cardboard
  - Plastic bottles can be recycled as fleece clothing
- **THE CARBON CYCLE**



- **Removing carbon dioxide from the atmosphere – photosynthesis in plants:**
- Carbon dioxide may diffuse into a leaf to take part in photosynthesis (→removing carbon dioxide from the atmosphere)
- Photosynthesis equation: carbon dioxide + water → glucose + oxygen
- **Carbon compounds are passed along food chains:**
- When primary consumers eat plants (producers), the carbon compounds contained within plants are passed along the food chain to the primary consumers

- When the primary consumers are eaten, the carbon compounds are in turn passed on to the secondary consumers etc...
- **Returning carbon dioxide to the atmosphere:**
- 1. Respiration in plants and animals:
  - Both plants and animals use glucose for respiration. This process releases carbon dioxide back into the atmosphere.
  - Respiration equation: glucose + oxygen → carbon dioxide + water
- 2. Decomposition of dead animals/plants by microorganisms:
  - When plants and animals die, decomposers (e.g fungi, bacteria) break down the carbon-containing compounds in their bodies and use them for respiration
  - Respiration produces carbon dioxide → decomposers decaying dead organisms also releases carbon dioxide into the atmosphere
- 3. Burning of fossil fuels:
  - Sometimes dead plants or animals are buried quickly underground before decomposer organisms can begin decaying them
  - Over millions of years, dead organisms underground are changed by heat and pressure into fossil fuels –
  - Fossil fuels contain carbon compounds → when they burn, carbon dioxide is released into the atmosphere
- **THE NITROGEN CYCLE**



- Nitrogen (in the form of nitrates) is useful to both plants and animals as it is used to make proteins, which are important for growth
- **How plants obtain nitrogen (they can't get it directly from the air as it is too unreactive):**
- Decomposers that feed on dead plants and animals break down some of the proteins and urea into ammonia
- Nitrifying bacteria in the soil convert ammonia into nitrates
- There are also nitrogen fixing bacteria in the soil that can directly 'fix' nitrogen gas into nitrates
- Plants can then absorb the nitrates through their roots, and use them for growth (when plants are eaten by consumers, the nitrogen in the plants get passed on)
- **How nitrogen is returned to the atmosphere:**
- When soils are lacking in oxygen, e.g when waterlogged... → denitrifying bacteria will convert nitrates back into nitrogen gas