

# Structure of DNA

## **DNA= Deoxyribonucleic acid**

- Carrier of genetic information
- Controls cell activities and gives you your traits
- Found **only** in the **nucleus** – NEVER LEAVES
- Made up of nucleotides joined together

## **Nucleotides**= smallest basic unit of DNA

3 parts to nucleotides:

1. sugar = deoxyribose
2. phosphate group
3. Nitrogen base (4 of these)

Adenine (A)	Thymine (T)	PAIRED
Guanine (G)	Cytosine (C)	PAIRED

- Individual nucleotides are held together by **hydrogen bonds** between bases to form a chain of DNA
- Shape = double helix

**Gene** = small strand of DNA – codes for a particular protein or trait

**Chromosome** = long strand of DNA – has many genes on it.

Humans have 46 chromosomes

## **DNA replication:**

- Occurs during mitosis so there is a copy of the DNA for the new cell.
- **STEPS:**
  - 2 Strands separate for replication “unzip”
  - Complementary base pairing occurs to form new DNA: A-T & G-C
  - Bonds replaced

# ROLE OF DNA IN EVOLUTION

**Evolution** = Theory that groups of organisms change over time to look different from their ancestors.

“Primordial/Organic soup” → single celled organisms in sea → multicellular organisms in sea → fish start to breathe air → walk on land (mudskipper) → develop lungs → land animals.

Bacteria and algae oxygenated the Earth

**Sexual reproduction** = exchange of genetic information

- Leads to variation – half the genetic information from each parent
- Differences due to different genes found on the chromosomes
- Increases organisms chances for survival
- Mutations can be passed on by sexual reproduction – drives evolution
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**Mutations** = permanent change in the DNA of cells

**=MAIN SOURCE OF NEW ALLELES**

Diversity of life is necessary:

If organisms, or species, are too similar then they:

1. won't be able to adapt to changes that occur
2. could get wiped out by a virus

**Species**= A species is an organism that can interbreed and produce fertile offspring and the individual all look similar.

## Evidence for Evolution comes from:

1. **Fossils** = preserved remains of ancient organisms. Formed when plant or animal matter is changed to stone or the "imprint" is solidified.

**Fossil record**= collection of fossils that show change within a species overtime (history of organisms)  
Has "gaps" in it so it is said to be incomplete. (Transition fossils are missing)

2. **Tar pits**=teeth and bones have been found where animals were trapped in thick mud which later became tar pits.

3. **Amber**= hardened gum/sap of a tree = insects usually trapped

4. **Flash frozen**= Organism quickly frozen in ice. Woolly Mammoth found nearly intact

5. **Comparative Anatomy**= what similar structures did the animals have, then lose or gain, compared to animals of today: skeletal, nervous, circulatory

6. **Embryology**= In vertebrates, the early stages of development look very similar with tails and gill slits. Therefore, similar ancestors – embryology traces evolutionary pathway

7. **DNA** = DNA has the same structure for every living thing on Earth

## Natural Selection

DARWIN'S theory of evolution  
= nature "selects" the organisms that survive.

### **5 IDEAS:**

1. **Overpopulation**: Groups of organisms tend to overpopulate – reproduce until something stops them (usually food).

2. **Competition**: over limited resources (food, water, shelter, mate).

3. **Variation**: different traits exist among members of the same species that are passed on to offspring.

4. **Survival of the fittest**: those individuals that have a genetic trait which gives them an advantage over others of the same species = they have adapted well to their environments.

5. **New species**: results by inheritance of trait(s), on genes, that give them an advantage over others.

**Speciation or Adaptive radiation**: where one species gives rise to one or more other species.

**Adaptation**: hereditary characteristic that provides an advantage for survival and reproduction.

Ex) Darwin's Finches

Ex) Peppered Moth

Ex) Antibiotic resistant bacteria

Ex) Pesticide resistant mosquitoes

### **3 ways natural selection acts on a population:**

1. If the environment favours the average of the distribution, the selection is called stabilizing selection
2. If the environment favours **one extreme**, the selection is **directional**
3. If the environment favours **both extremes**, the selection is **disruptive**

## Factors which influence genetic variation

### Factors which increase genetic variation

1. **Mutations**
  - Permanent change in DNA
  - Main source of new alleles
2. **Gene flow –**
  - Individuals of different populations immigrate or emigrate between populations of the same species
  - Brings new genes into a population – adds variation to gene pool – new alleles
  - Prevents specialization to environment
3. **Recombination –**
  - parts of chromosomes switch parts
  - crossing over during meiosis

### Factors which decrease genetic variation

1. **Natural selection** – covered already
2. **Genetic Drift**
  - Random or chance change in the frequency of a gene
  - A change in allelic frequency over time due to chance
  - Eg. a natural disaster could wipe out a large number of animals of a species. Those that survived are able to reproduce – not necessarily the strongest / fittest – luck
3. **Non-random mating**
  - Some organisms have more opportunity to mate than others & therefore produce more offspring (& more copies of their genes).
  - **Has more desirable trait**
  - **2 reasons for non-random mating**
  - Simply easier to mate with a nearby individual (rather than one far away).
  - Competition for mates occurs among animals = active selection of mating partner (not random)

## CONVERGENT VS DIVERGENT EVOLUTION

### CONVERGENT EVOLUTION:

=Evolution toward the **SAME** type of adaptation amongst different groups of organisms.

→produces **analogous structures** which have the **SAME FUNCTION** but different structure

Ex. Wing of an insect and wing of a bird

Both are used for flying (function) but each has a very different structure.

Bird= muscle, bone, feathers, skin, tissue

Insect = cartilage rods with a membrane over it

### DIVERGENT EVOLUTION:

= Evolution which led to **DIFFERENT** structures developing from an original body plan.

→produces **homologous structures** =**DIFFERENT FUNCTION** but same structure due to a common ancestor.

Ex. Forelimb of mammals = same bone pattern (structure) but each limb is specialized/adapted to the animal's way of life (function).

Human: grasping (hand)

Whale/dolphin : swimming (flipper)

Bat : flying (wing)

**Leads to speciation** (one species giving rise to another)

## **VESTIGIAL STRUCTURES:**

=Remnants of a structure that had a function in an ancestor but no longer does in the evolved organism.

Examples:

- Appendix- used to have more of a function in digestion
- Tail bone
- Snake hips – some have pelvis bone but no legs
- Chickens have tooth gene but no teeth

## **Rate of Evolutionary Change**

### **GRADUALISM**

- Evolutionary change that occurs slowly & constantly over time.
- Based on evidence from the fossil record where some organisms have evolved slowly (in geological time)

Ex. Sharks, crocodiles, cockroaches, horseshoe crab

### **PUNCTUATED EQUILIBRIUM**

- There is a period of stability, where little change, if any occurs.
- However, this is followed by periods of rapid change to a species of plant or animal
- Can be caused by environmental conditions such as an ice age. Some species will die off but others will need to change quickly and adapt to new environments – therefore, rapid evolution
- Animals with higher reproductive rates are better able to adapt. Therefore, new opportunities presented for survivors

Ex. Mammals, birds

### **Endangered Species**

- wild species with so few survivors that the species could soon become extinct
- examples:

### **Extinction**

- complete disappearance of a species from the Earth
- stops evolution of that animal
- leaves niches open for other animals to “fill” → increases speciation of other organisms

### **Factors Causing Extinction**

- Pollution
- Climate change
- Hunting/poaching
- Invasive species
- Loss of habitat
- Speciation
- Can you think of others??