

GETTING A MESSAGE THROUGH

GENE MUTATIONS

NOBODY'S PERFECT



DNA MUTATIONS PRODUCE GENETIC DIVERSITY WITHIN A POPULATION

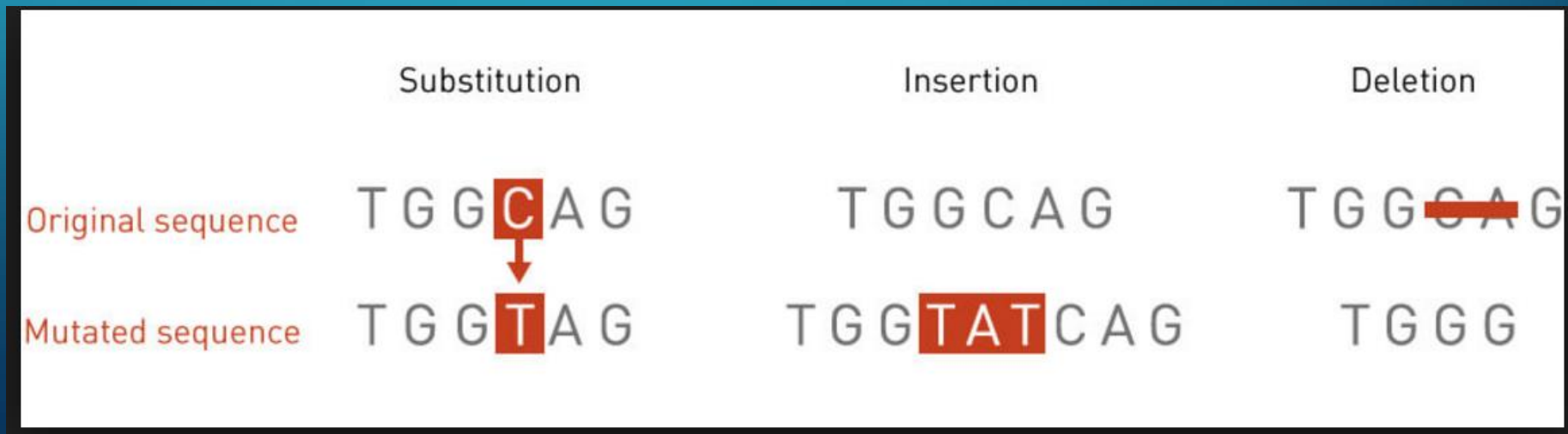
- Variety exists within the same species because of genes.



Figure 1.21: The kittens in this litter have different fur colour and patterns, partly because each kitten inherited a different combination of alleles from its parents.

WHAT IS A GENE MUTATION?

- Mutations: a permanent change in the genetic material of an organism
- They can occur during DNA replication.
- In a mutation, the DNA code will have one or more bases that are missing, added or changed in some way

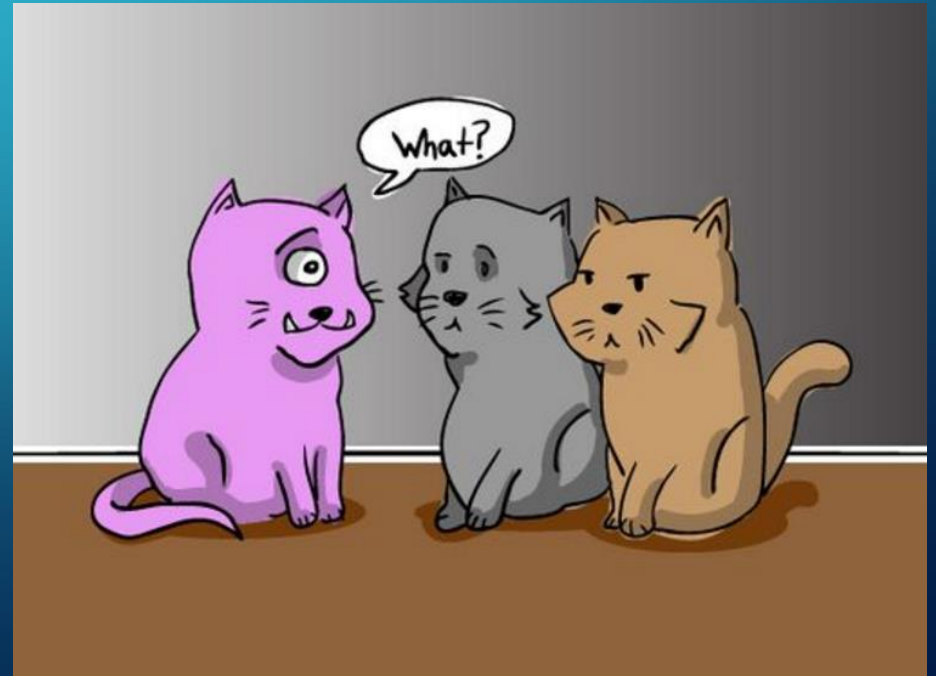


HOW COMMON IS THIS? IS IT DANGEROUS

- Everyone had about 6 mutations in each cell in their body!
- However having a mutation does not mean you will see a physical change or that it will affect the function of that gene.
 - Mutations can be
 - Some mutations can be harmful and can cause a cell to die, malfunction, or multiply uncontrollably.
 - Beneficial
 - No effect

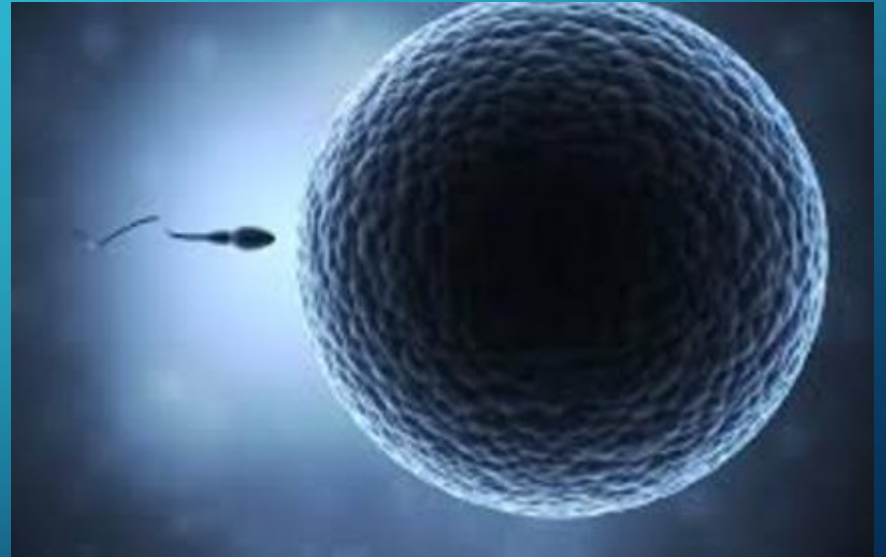
HOW DO MUTATIONS AFFECT A POPULATION?

- Mutations are a major source of genetic variation in a population
- Some variations may help them survive better
- Can you think of any examples??



CAN YOU INHERIT A MUTATION?

- Only mutations in the gametes (egg and sperm cells) can be passed to offspring
- Mutations in body cells only affect the organism they occur in



TYPES OF MUTATIONS

- Point mutation
 - Occurs when the base sequence is changed
 - EX: GCA is changed to GAA
- There are 3 types
 - Substitution
 - Deletion
 - Insertion



SUBSTITUTION

Normal DNA: CGA – TGC – **ATC**

Alanine – Threonine - stop

Mutated DNA: CGA – TGC – **T**TC

Alanine – Threonine - Lysine

**What has happened to
the DNA?**

- A single nitrogen base is substituted
- It may or may not affect the amino acid or protein

LETS TRY

- On a piece of paper write:
 - THE CAT ATE THE RAT
 - Change one letter to represent a substitution mutation
 - How does this affect the sentence?



INSERTION

Normal DNA: CGA – TGC – ATC

Alanine – Threonine – stop

Mutated DNA: CGA – TAG – CAT – C

Alanine – Isoleucine – Valine

**What has happened
to the DNA?**

- A nitrogen base is added to the sequence
- It causes the triplet frames to shift
- It ALWAYS affects the amino acids and therefore proteins

TRY THIS

- Write down
 - The cat ate the rat
 - Insert a letter into any word above
 - Rewrite the sentence, each word must have only 3 letters
 - What are the effects???



- By inserting a letter your sentence no longer makes sense
- Insertions may have huge effects

Insertion

The cat ate the rat.

The **c**ca tat eth era t.

Inserting the **c** causes a

FRAMESHIFT

DELETION

Normal DNA: CGA – TGC – ATC

Alanine – Threonine – stop

Mutated DNA: CGA – TCA- TC

Alanine – Serine

**What has happened
to the DNA?**

- A nitrogen base is deleted or removed
- Causes a shift
- It always affects the amino acids and therefore the protein

TRY THIS

- Write this down
 - The cat ate the rat
 - Delete one letter
 - Rewrite sentence (remember you need 3 letters per word)
 - What has happened??



- The sentence no longer makes sense !
- Deletions can have huge effects!

DELETION

The cat ate the rat.

Thc ata tet her at

FRAMESHIFT

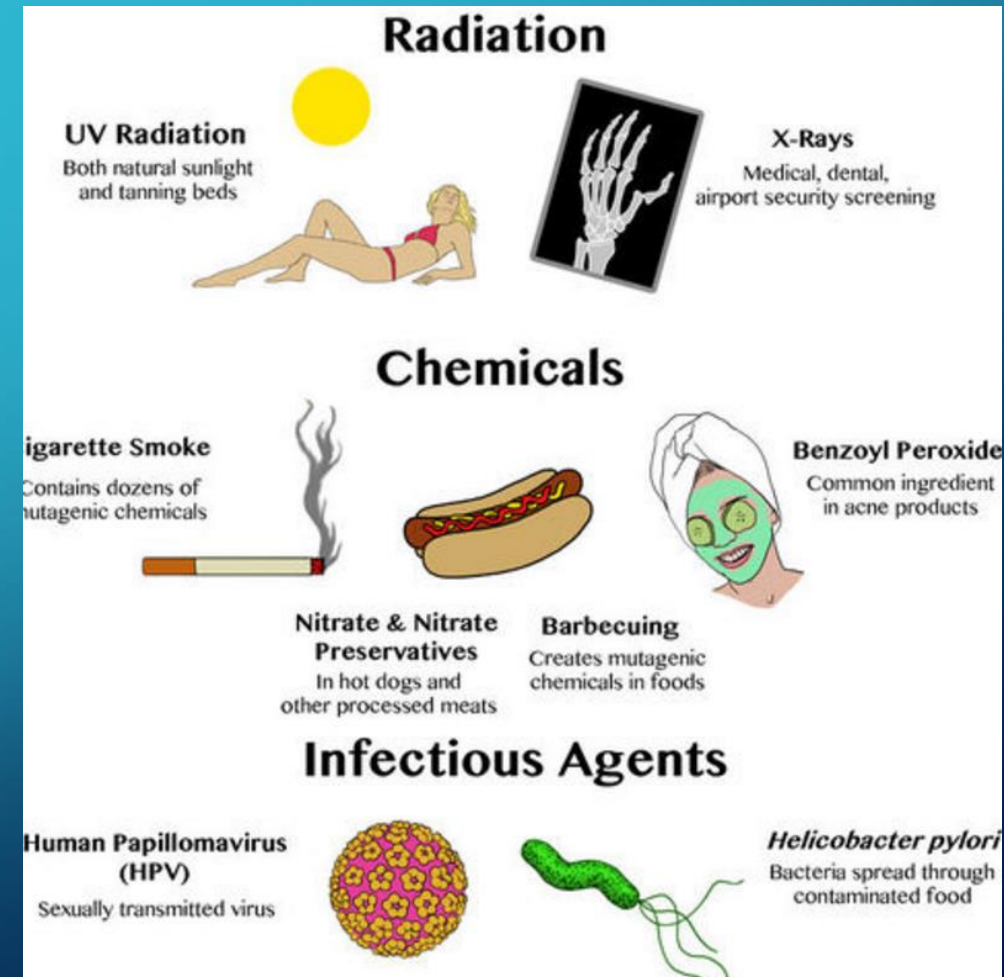
WHICH MUTATIONS HAVE THE LEAST EFFECT?



- Substitution has the least affect because it only changes ONE amino acid, or no amino acid
- Frameshift mutations (addition/deletion) change the whole thing

CAUSES OF MUTATIONS

- There are many things that can cause a mutation
- Natural error
 - During DNA replication etc
- Environment
 - Mutagens
 - Chemicals
 - Radiation



DISCUSSION QUESTIONS

1. What is a mutation? Are all mutations harmful? Explain.
2. Explain why mutations are the starting point for genetic variation.
3. What are the three types of point mutations?

ENVIRONMENTAL FACTORS CAN CAUSE MUTATIONS.

- **Mutagen:** a substance or event that increases the rate of mutation
- *Physical mutagens* cause physical changes in the DNA (i.e., X-rays and UV radiation).
- *Chemical mutagens* can chemically react with DNA (i.e., nitrites and gas fumes).

CARCINOGENS

- **Carcinogen:** a substance or agent that causes cancer
- Some mutagens are carcinogenic.
 - Examples include UV radiation, cigarette smoke.
 - Wearing sunscreen, a hat, and sunglasses can reduce the exposure to UV radiation.



Figure 1.29: Applying sunscreen before going out in the sun can help reduce a person's exposure to ultraviolet radiation.

LET'S MAKE SOME BEES!

