

# GENE MUTATIONS VIDEO ABOVE

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

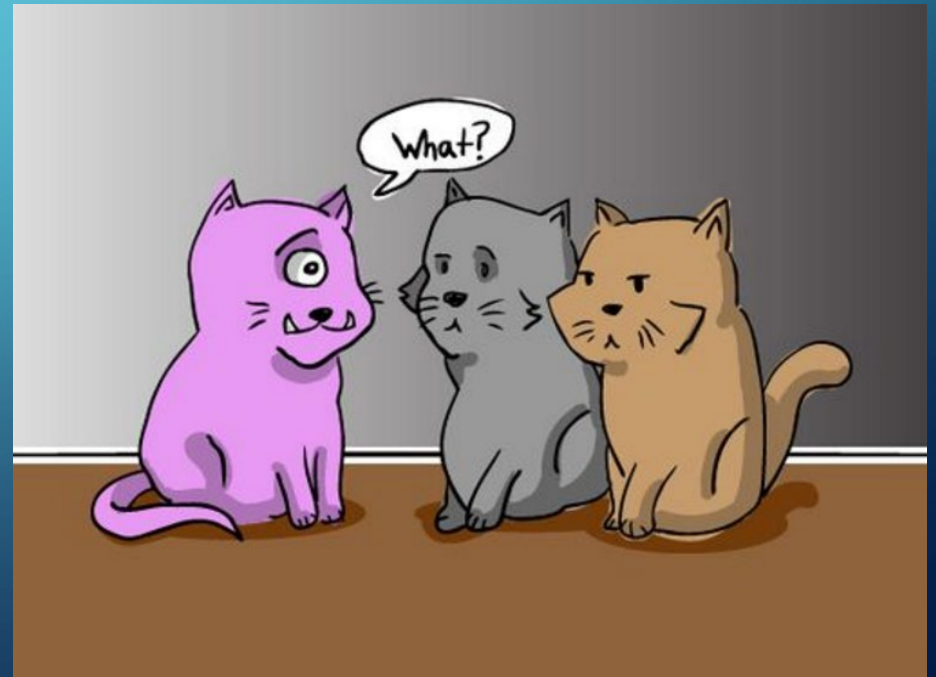
	Substitution	Insertion	Deletion
Original sequence	T G G <b>C</b> A G	T G G C A G	T G G <del>C A G</del>
Mutated sequence	T G G <b>T</b> A G	T G G <b>T A T</b> C A G	T G G G

# 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****

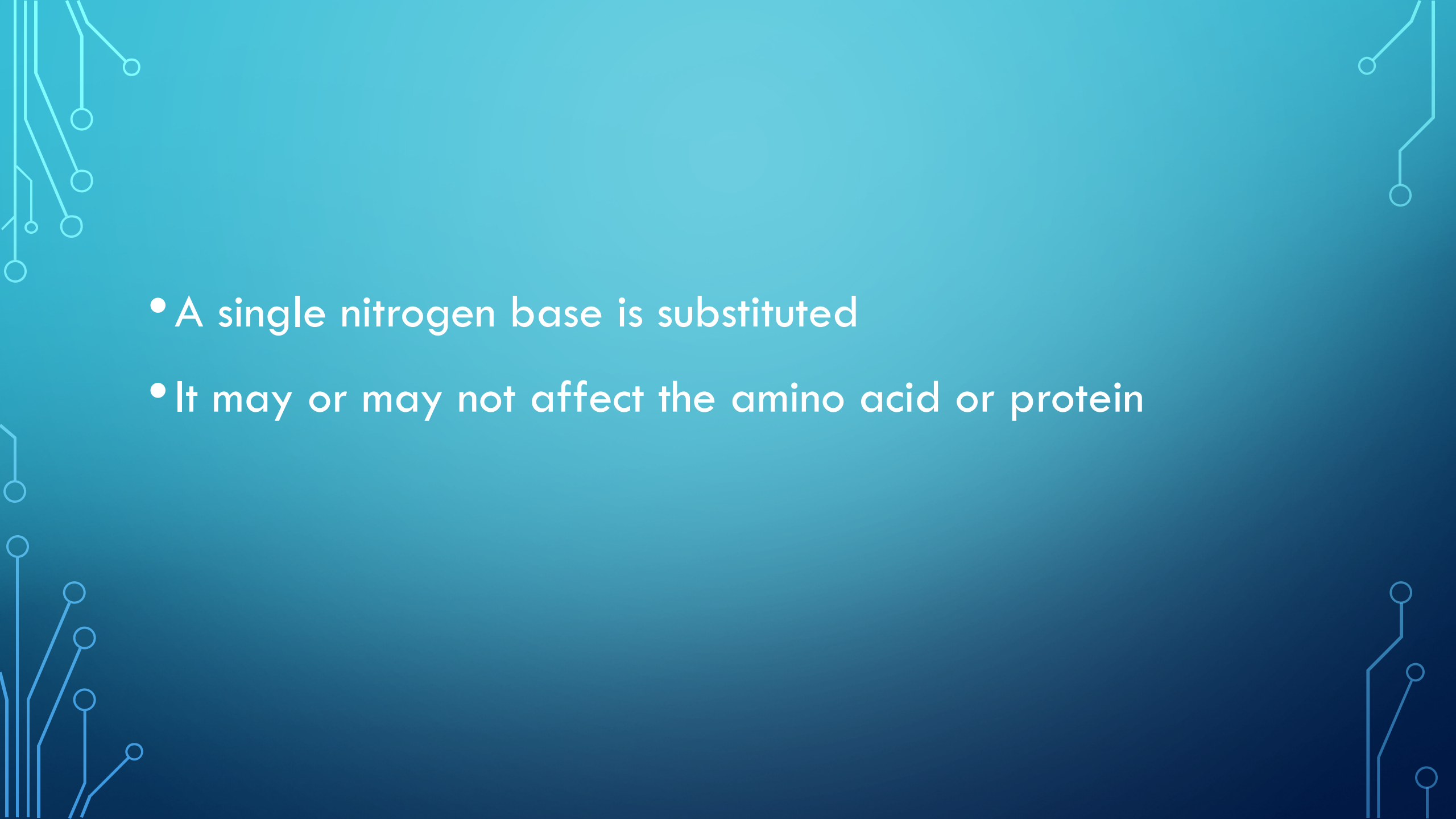
**Alanine – Threonine - stop**

***Mutated DNA: CGA – TGC – **TTC*****

***Alanine – Threonine - Lysine***

**What has happened to  
the DNA?**



- 
- The background is a blue gradient. In the corners, there are decorative white line art elements resembling circuit boards or neural networks, with lines and small circles.
- 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**

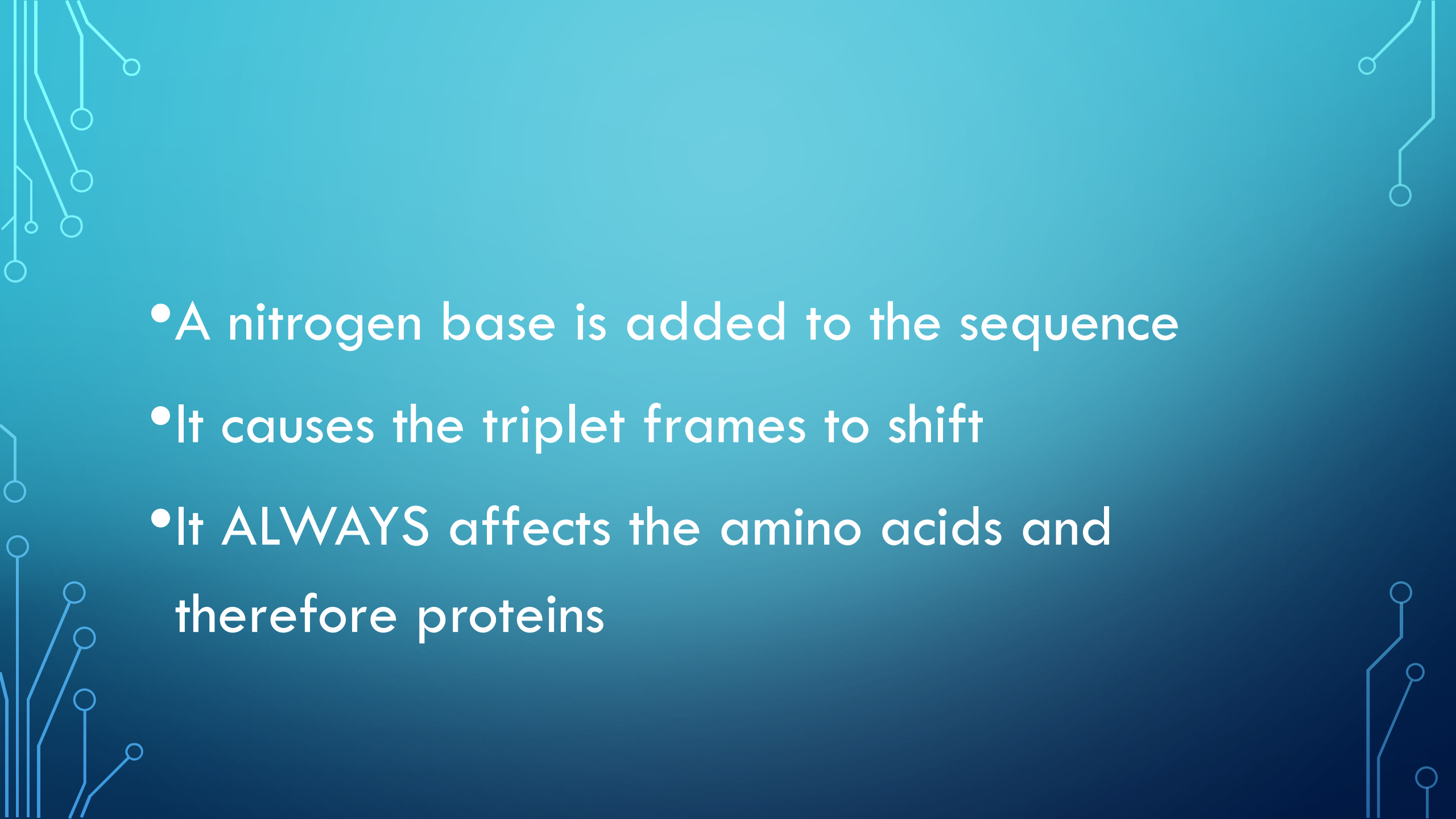
**Alanine – Threonine – stop**

***Mutated DNA: CGA – TAG – CAT – C***

***Alanine – Isoleucine – Valine***

**What has happened  
to the DNA?**



- 
- The background is a blue gradient. In the corners, there are white line-art illustrations of circuit boards or neural network connections, with lines and small circles representing nodes.
- 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

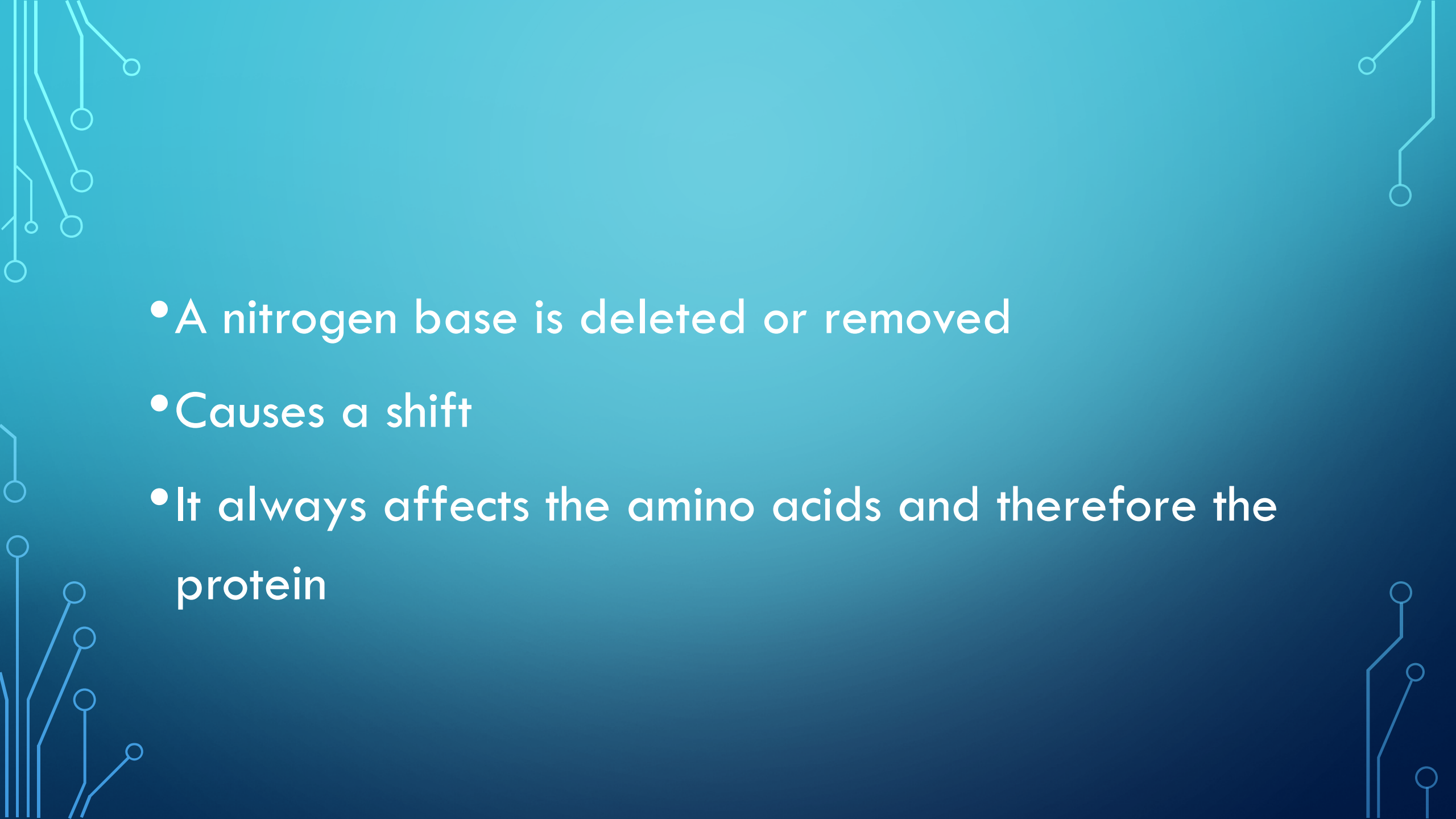
**Normal DNA: CGA – TGC – ATC**

**Alanine – Threonine – stop**

***Mutated DNA: CGA – TCA- TC***

***Alanine – Serine***

**What has happened  
to the DNA?**

- 
- The background is a solid blue gradient. In the corners, there are decorative white line art elements resembling circuit boards or neural networks, with lines and small circles connecting them.
- 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

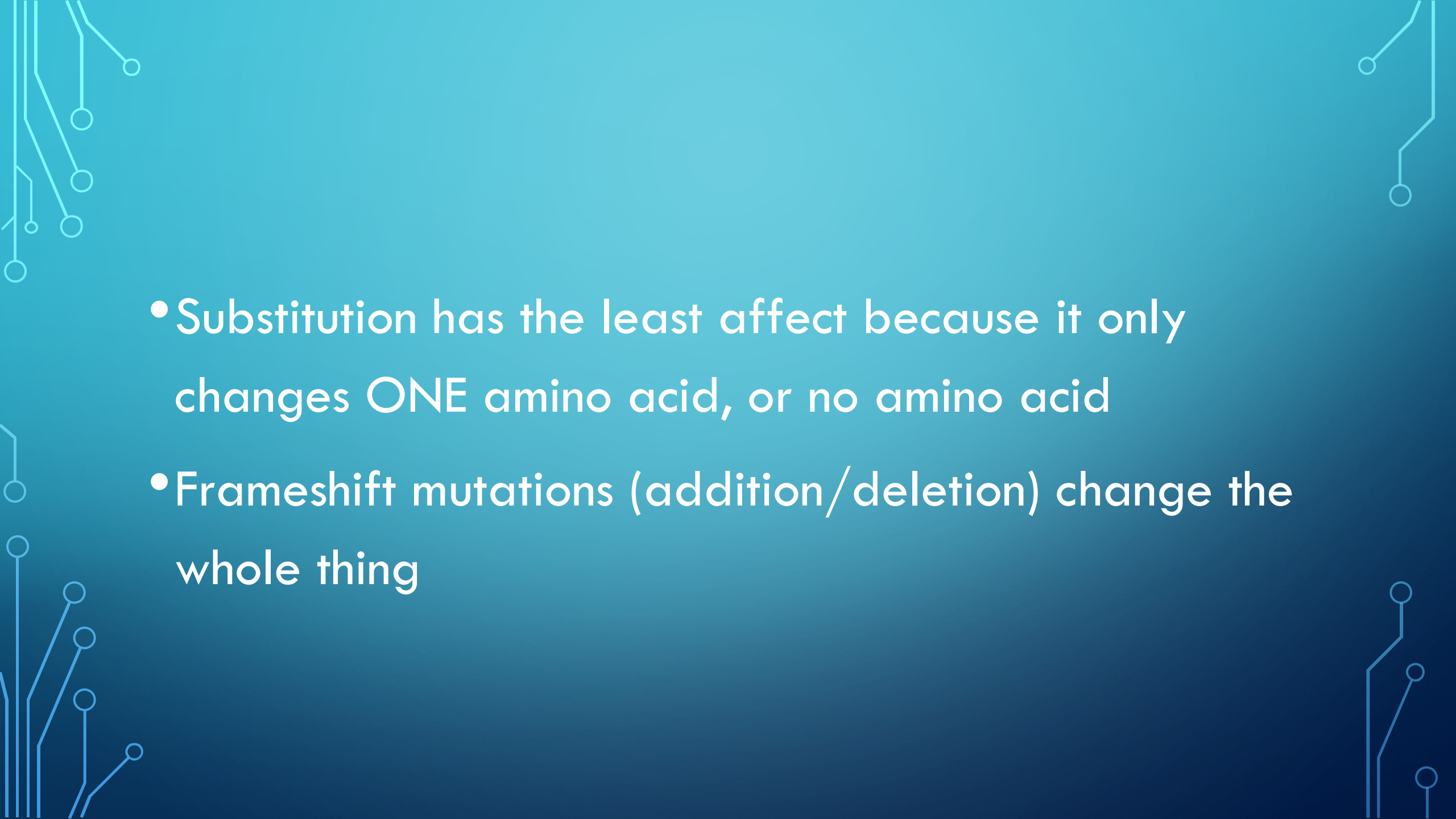
The cat ate the rat.

Thc ata tet her at

## FRAMESHIFT

# WHICH MUTATIONS HAVE THE LEAST EFFECT?

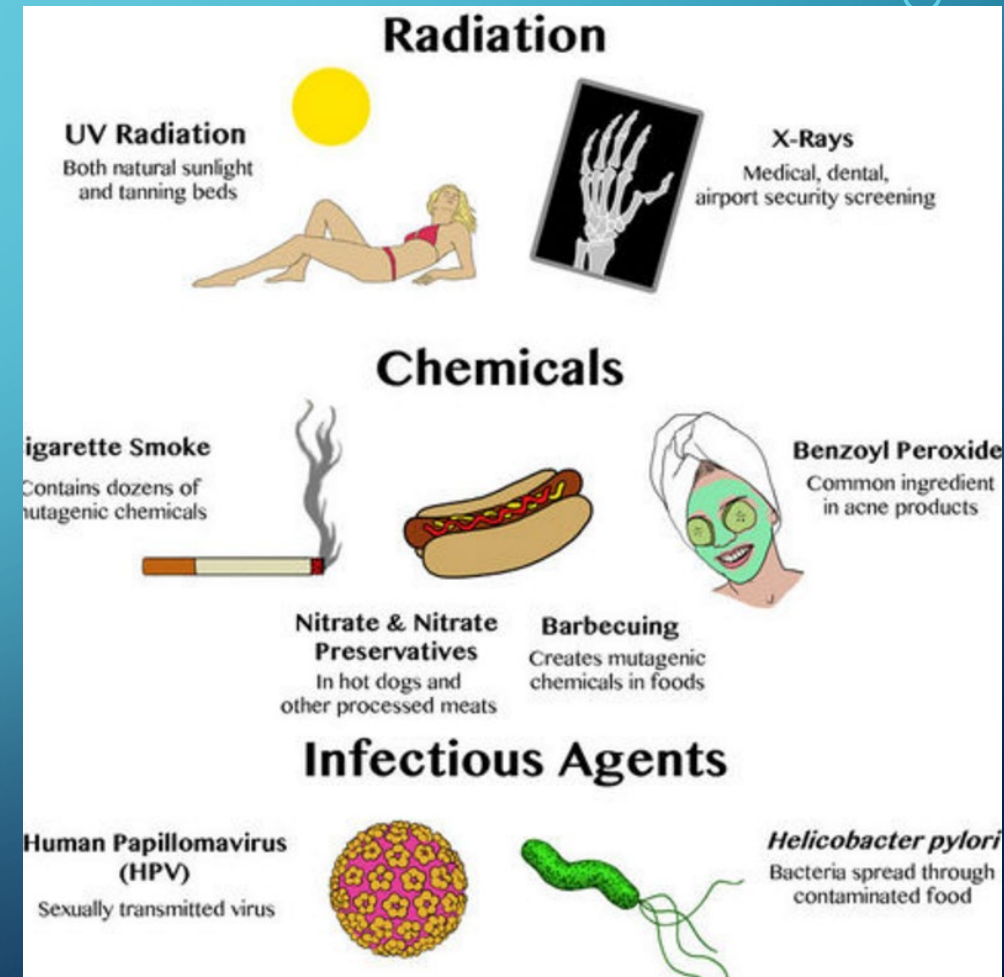


- 
- The background is a solid blue gradient. In the corners, there are decorative white line art elements resembling circuit boards or neural network connections. These elements consist of thin lines that branch out and terminate in small circles.
- Substitution has the least affect because it only 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?

## DISCUSSION QUESTIONS

1. What is a mutation? Are all mutations harmful? Explain.

1. Mutations are changes to an organisms genetic code. Mutations can be harmful (cancer), beneficial (white fur in the arctic) or have no effect.

2. Explain why mutations are the starting point for genetic variation.

1. Mutations introduce new alleles into the population. Proteins made can change which brings variation to the population. For example: Blue eyes are a mutation, it brought a new phenotype into the population.

3. What are the three types of point mutations?

1. Substitution, Deletion, Insertion



# 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.



# MUTATION ACTIVITY

