# INTRODUCTION
# TO BIOINFORMATICS

Discovering the World of Biology and Computer Science

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# Fields in Bioinformatics

01 SEQUENCE ANALYSIS

02 GENOME ASSEMBLY

03 STRUCTURAL BIOINFORMATICS

04 PHYLOGENETICS

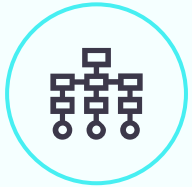
05 COMPARATIVE GENOMICS

06 TRANSCRIPTOMICS

07 PROTEOMICS

08 METAGENOMICS

# WHY LEARN ABOUT BIOINFORMATICS?



## BIOINFORMATICS

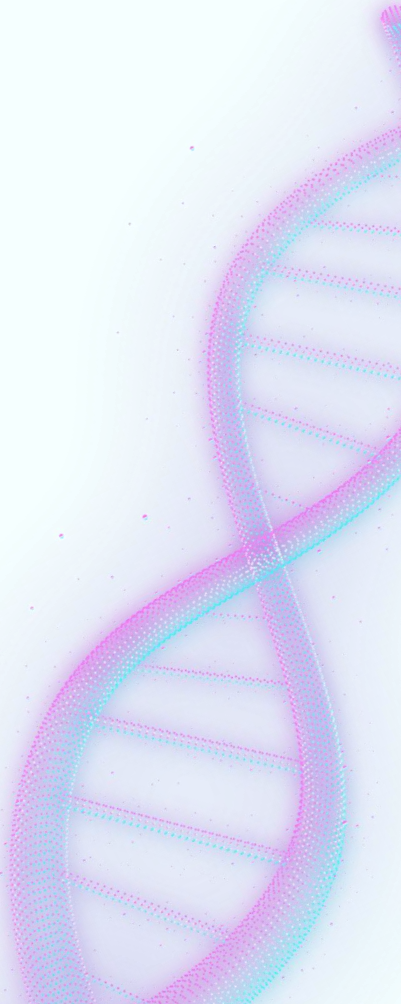
- It's a fast-growing field making big changes in the world.
- A fascinating mix of biology, computer science, and information technology.

## HOW IT HELPS

- Enables scientists to analyze and interpret biological information like DNA and proteins.
- Helps doctors and scientists fight diseases.

# INTRODUCTION TO CODING

- Through coding, we can solve problems and understand biology in ***new ways***.
- **Python** is the **most used** coding language used in bioinformatics.
- This is the **language** a computer speaks, just like we speak English.
- It is a **specific set of steps** to get the computer to do something.
- *Can you come up with any algorithms we see in real life?*



# WHY DOES IT MATTER?

## MEDICINE AND HEALTHCARE

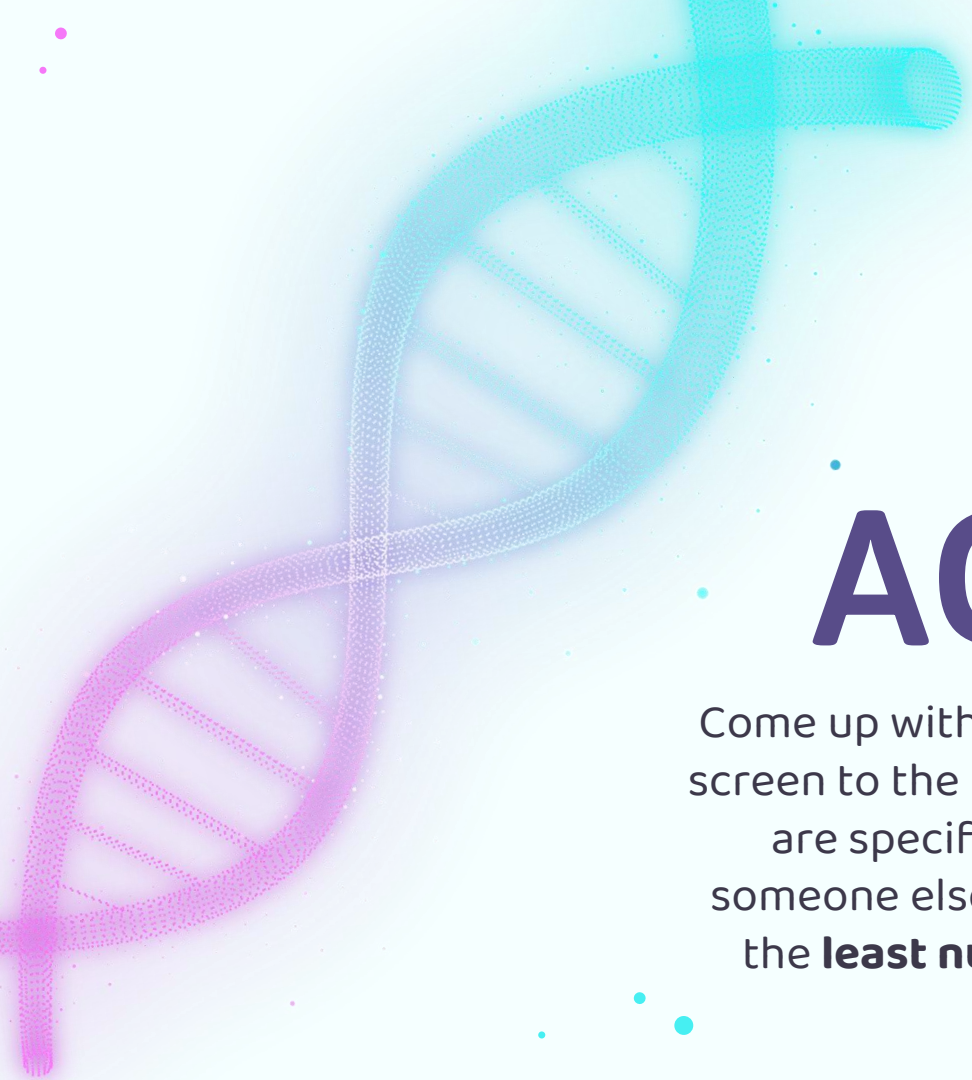
It's at the forefront of personalized medicine, helping tailor treatments to individual genetic profiles.

## DISCOVERING SPECIES

Aids in the discovery of new species and understanding evolutionary relationships.

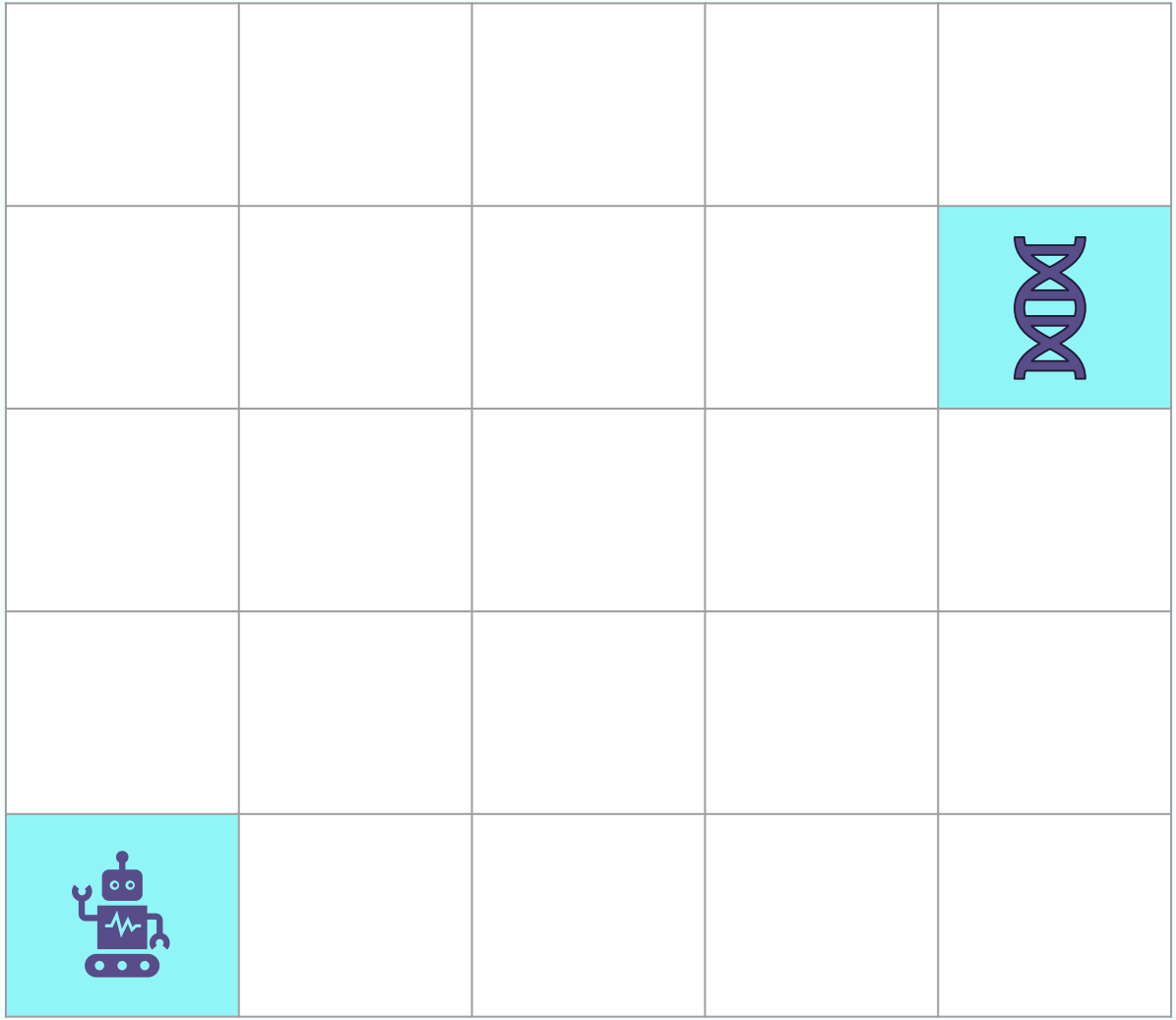
## PROBLEM SOLVING

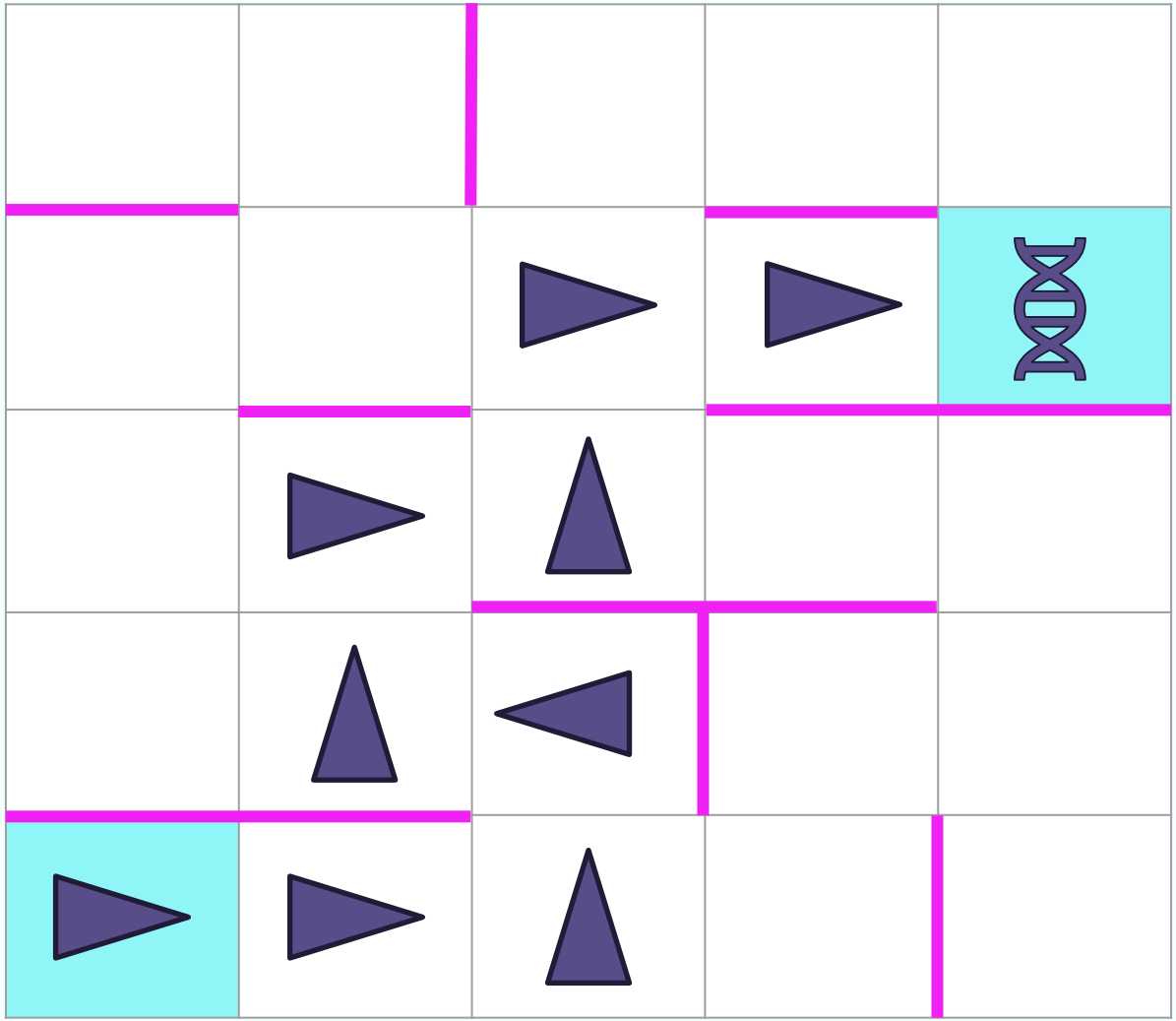
Essential for solving complex biological problems and fighting diseases.



# ACTIVITY 1

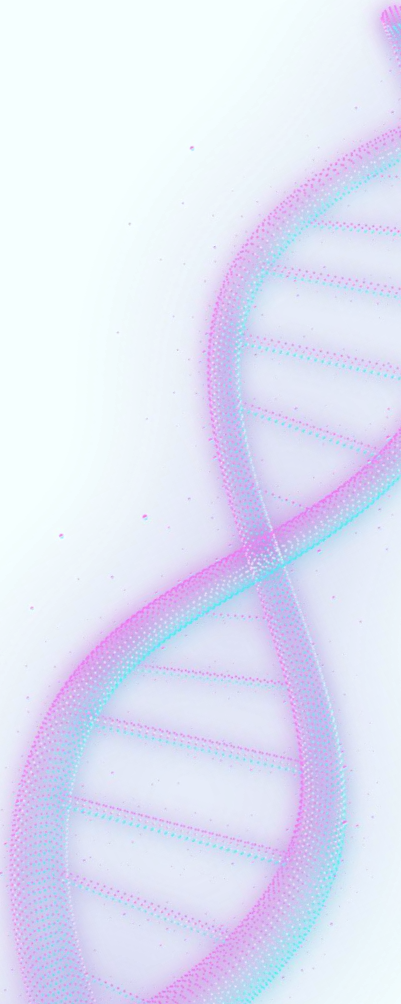
Come up with an **algorithm** to get the robot on the screen to the DNA molecule. Remember, algorithms are specific details you write for a computer, or someone else. Try to get to the DNA molecule with the **least number of steps.** **Robots are lazy too!**

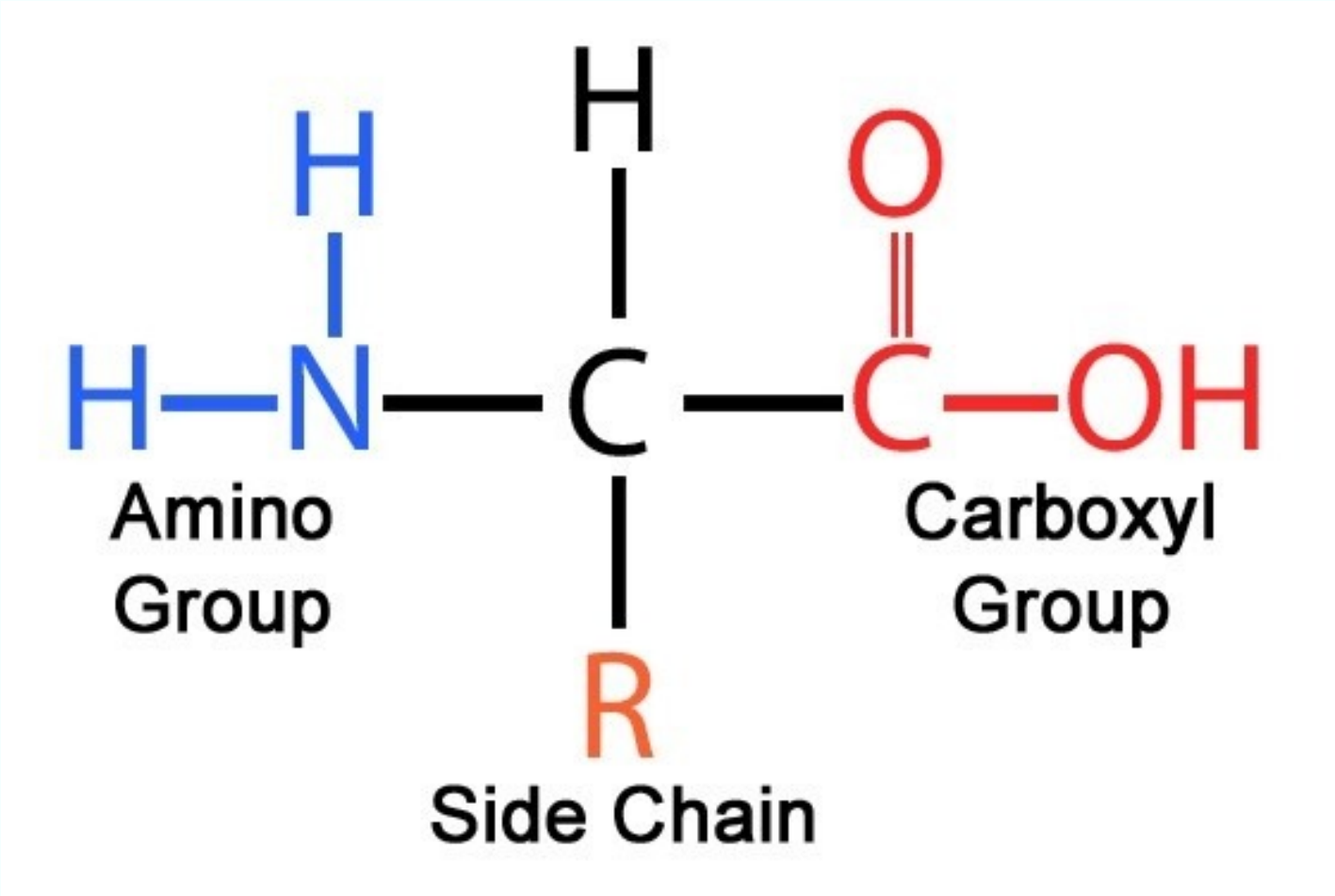




# PROTEOMICS

- **Proteomics** is the study of **proteins** in living things at the **molecular level**.
- Scientists use powerful **tools** and **techniques** to examine the **structure**, **function**, and **abundance** of proteins in cells and tissues.
- By studying proteins, scientists can uncover the causes of **diseases** and **develop** new **treatments and therapies** to improve human health.




H
H
O
H—N—C—C—OH
Amino Group
Carboxyl Group
R
Side Chain

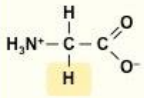
# ACTIVITY 2

In this mini competition, you will sort amino acids into **four groups** based on clues. We will set a timer for 3 minutes! First group to finish earns a prize!

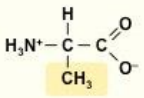
# ACTIVITY 2

# ANSWERS

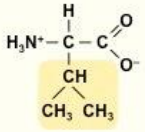
## NON-POLAR



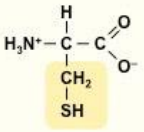
**Glycine**
(Gly / G)



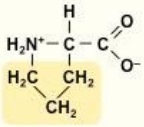
**Alanine**
(Ala / A)



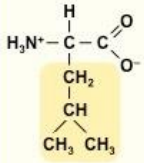
**Valine**
(Val / V)



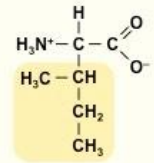
**Cysteine**
(Cys / C)



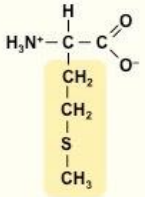
**Proline**
(Pro / P)



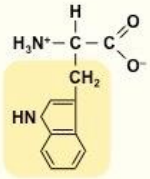
**Leucine**
(Leu / L)



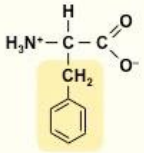
**Isoleucine**
(Ile / I)



**Methionine**
(Met / M)

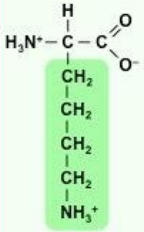


**Tryptophan**
(Trp / W)

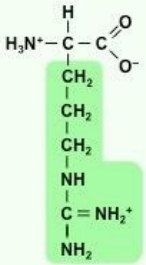


**Phenylalanine**
(Phe / F)

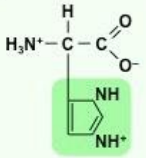
## + CHARGE



**Lysine**
(Lys / K)

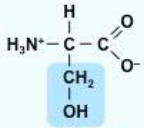


**Arginine**
(Arg / R)

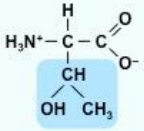


**Histidine**
(His / H)

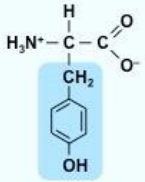
## POLAR



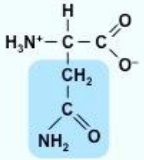
**Serine**
(Ser / S)



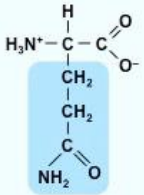
**Threonine**
(Thr / T)



**Tyrosine**
(Tyr / Y)

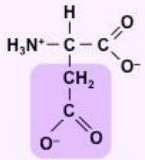


**Asparagine**
(Asn / N)

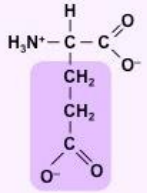


**Glutamine**
(Gln / Q)

## – CHARGE



**Aspartic Acid**
(Asp / D)



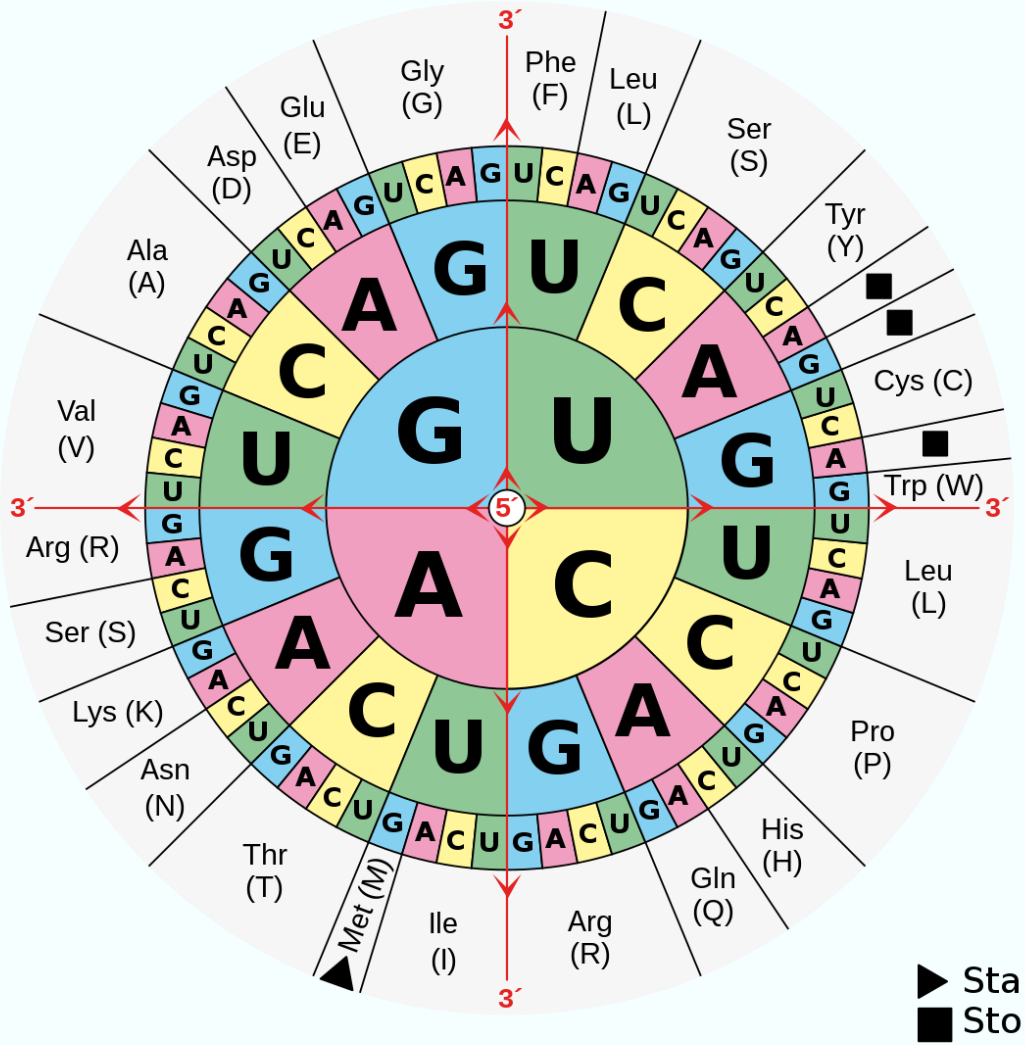
**Glutamic Acid**
(Glu / E)

| START: | | END: |
|---|---|---|
| AUG | CAU | UAG |
| | | UGA |
| | | UAA |

# ACTIVITY 3

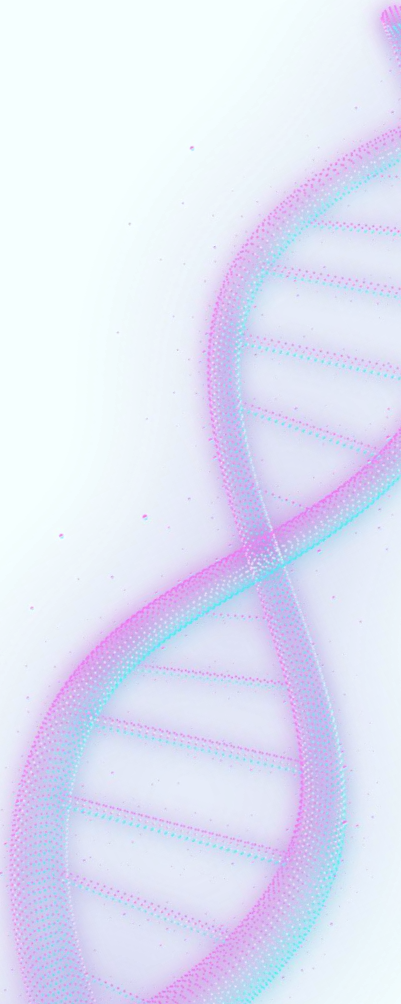
Write 10 sets of 3 letters from this list: **A, G, U, C**. MAKE SURE TO LEAVE SPACES BETWEEN EACH 3!! Next, pass your paper with your list to someone else. Then you will take your list of codons (3 set letters) and translate the amino acids from their mRNA code! Using the chart on the next slide:

E.G.: **AUG** CAU GUA ACU CUG CGU AGG GGU CCA **UGA**


3´
Phe (F)
Leu (L)
Ser (S)
Tyr (Y)
Cys (C)
Trp (W)
Leu (L)
Pro (P)
His (H)
Gln (Q)
Arg (R)
Ile (I)
Met (M)
Thr (T)
Asn (N)
Lys (K)
Ser (S)
Arg (R)
Val (V)
Ala (A)
Asp (D)
Glu (E)
Gly (G)
5´
3´
3´
Start
Stop

# DISCOVERING RNA AND DNA

- **DNA** and **RNA** are the **building blocks of life**.
- They carry the **instructions** for making you, you!
- These *molecules* carry **genetic information** from one generation to the next.
- You can discover your **ancestry** and **potential health predispositions** through **DNA**.
- Every living thing has its **unique DNA code**.
- Understanding them is the **first step** in bioinformatics.

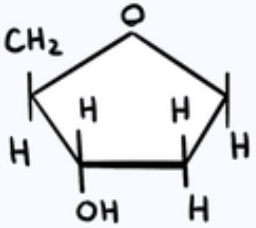


# DNA vs. RNA

## DEOXYRIBONUCLEIC ACID

DOUBLE-STRANDED SUGAR* PHOSPHATE

* DEOXYRIBOSE

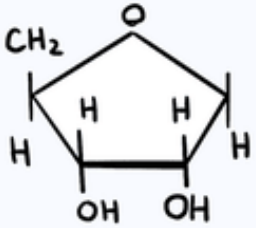



BASE PAIR

## RIBONUCLEIC ACID

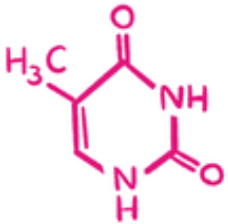
USUALLY SINGLE-STRANDED SUGAR* PHOSPHATE

★ RIBOSE

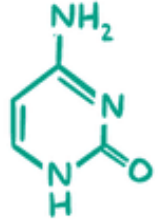



SINGLE NUCLEOBASE

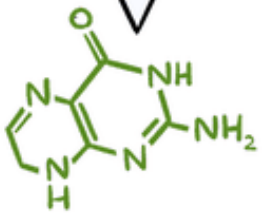
NUCLEOBASES



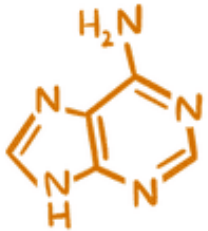

THYMINE



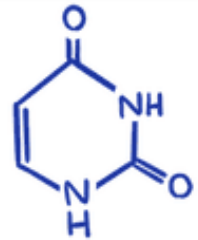

CYTOSINE




GUANINE




ADENINE




URACIL

Central Dogma
Protein Folding
Competitive Inhibition
Co-Factors
Non-Competitive Inhibition
Allosteric Site
Signaling Pathway

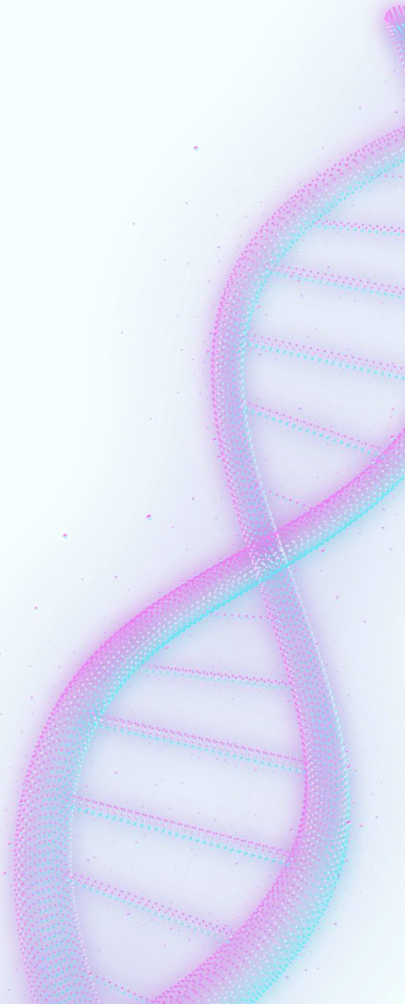
https://wheelofnames.com/

# ACTIVITY 4

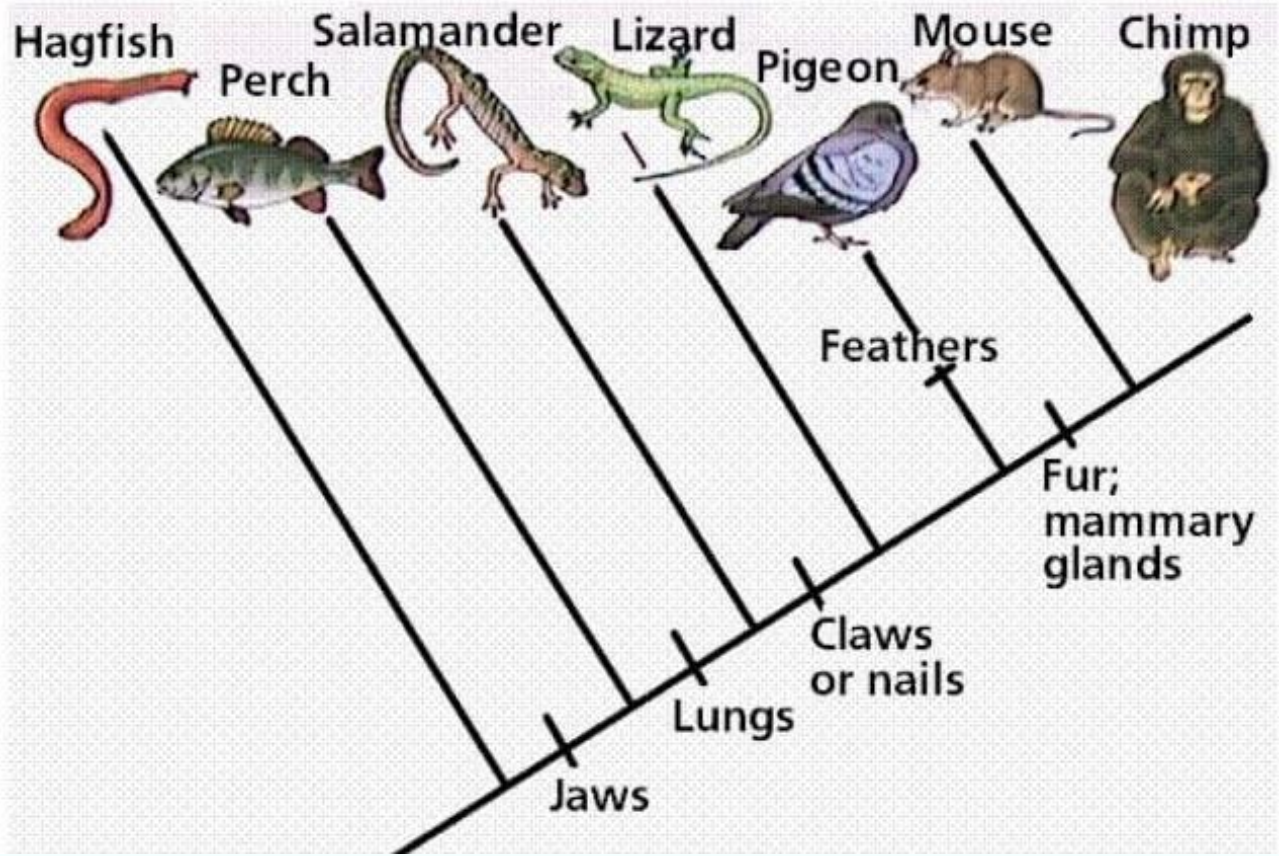
We will use a wheel to randomly assign your group a topic. You will use Play-Doh to model each topic, after researching. You have ten minutes, good luck!

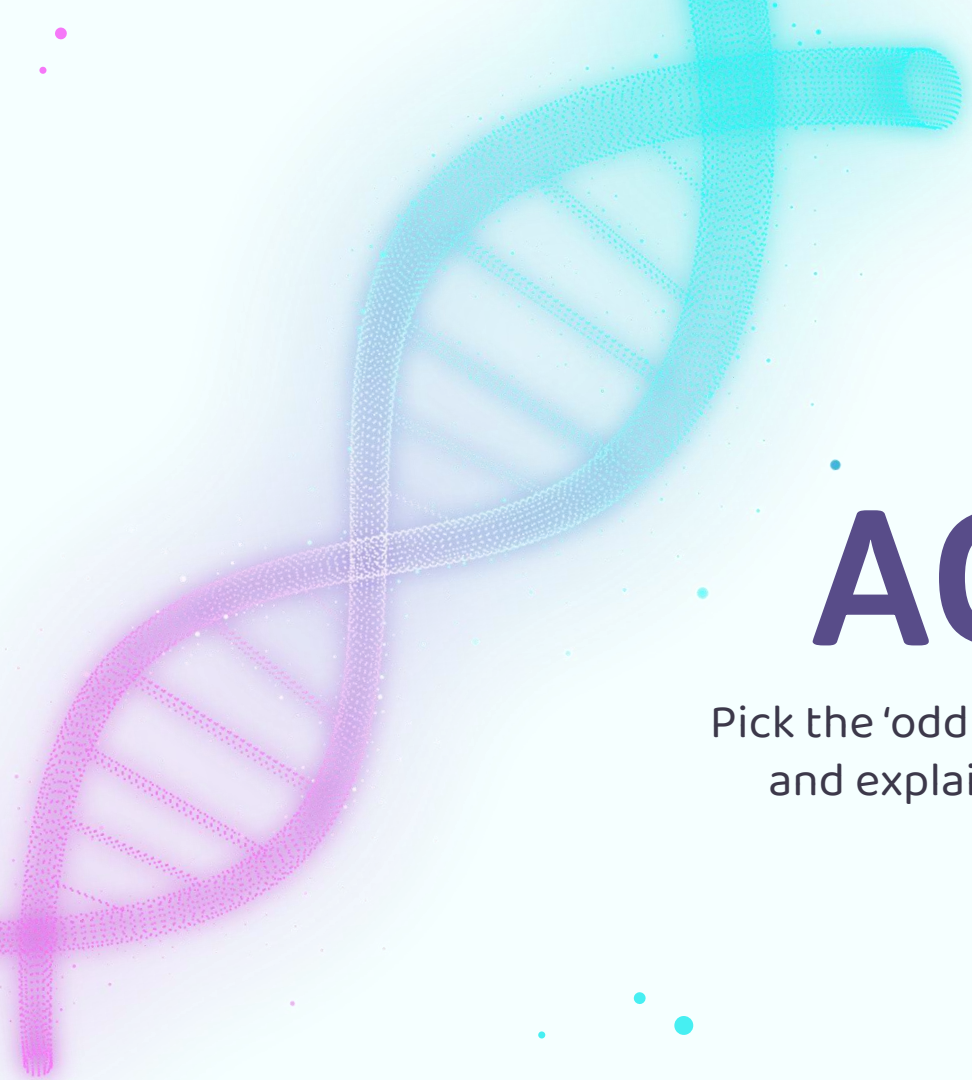
# PHYLOGENETICS

- Phylogenetics is like a **family tree** for living things.
- It helps scientists understand how different species are **related** to each other.
- Scientists study the **similarities** and **differences** in traits (like appearance, behavior, and DNA) among different organisms.
- They use this information to create diagrams called **phylogenetic trees**.
- Phylogenetics helps us learn about the **history of life** on Earth.



# CLADOGRAM


Hagfish
Perch
Salamander
Lizard
Pigeon
Mouse
Chimp
Feathers
Fur; mammary glands
Claws or nails
Lungs
Jaws



# ACTIVITY 5

Pick the ‘odd one out’ from the following 4 options and explain why they aren’t related to the other animals.

1



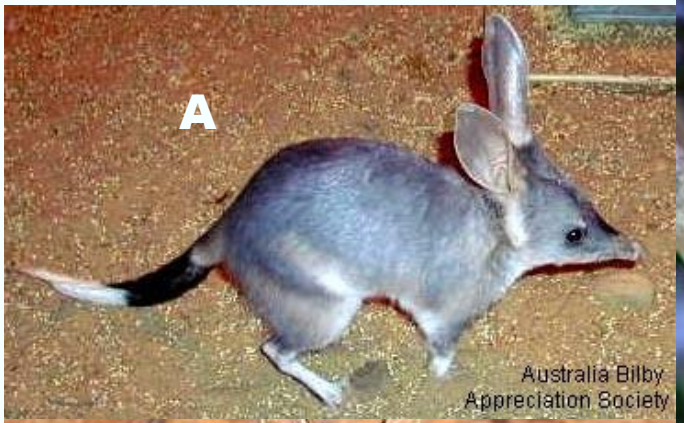


2


A
B
3
Dave Watts
C
D

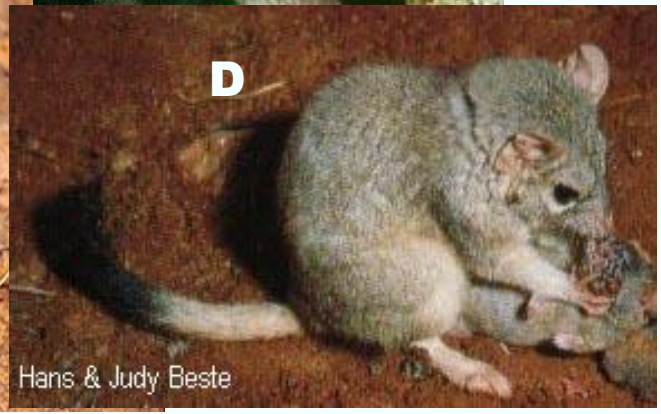

mongabay.com
A
B
4
C
D

5

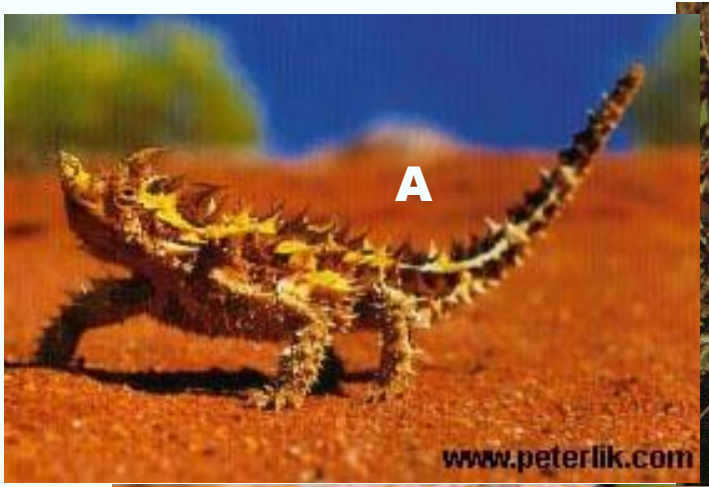

A
Australia Bilby
Appreciation Society


B
www.peterlik.com

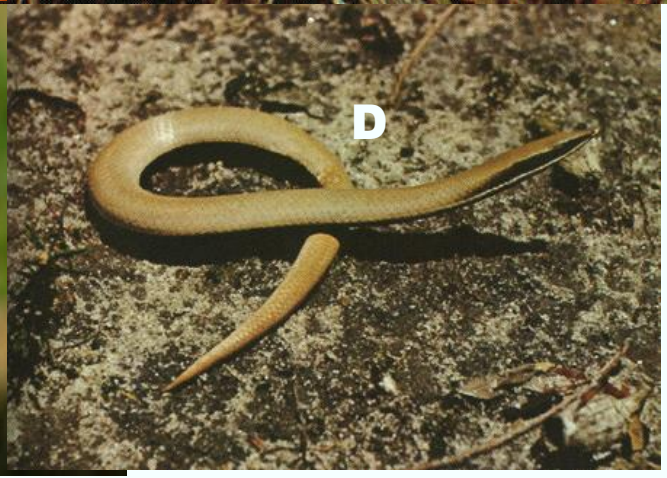

C

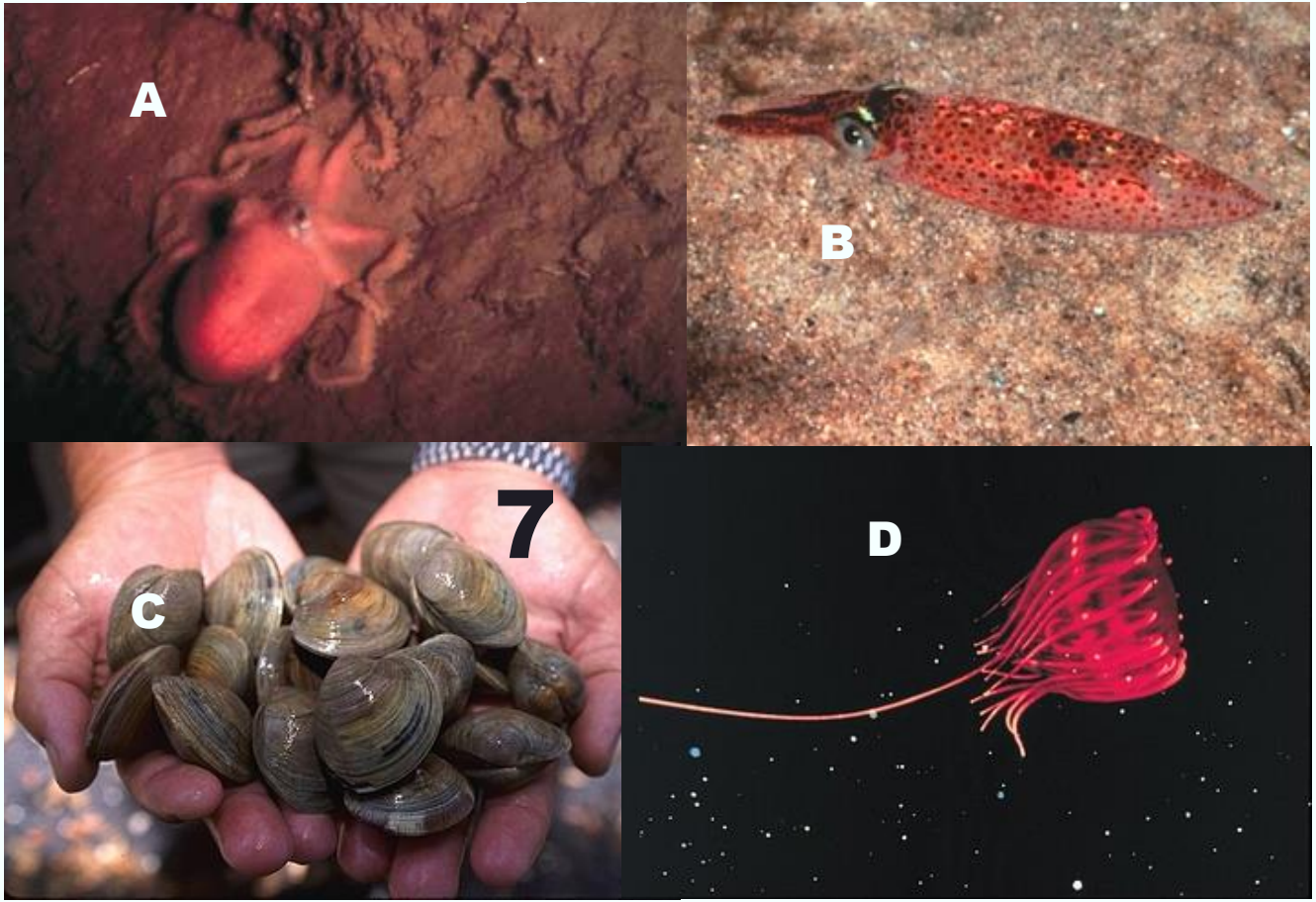

D
Hans & Judy Beste

6






A
B
C
7
D

# MAKING THE CONNECTION

Thousands of experiments

01

Predictions based on trial-error experiments

02

Manual data analysis

03

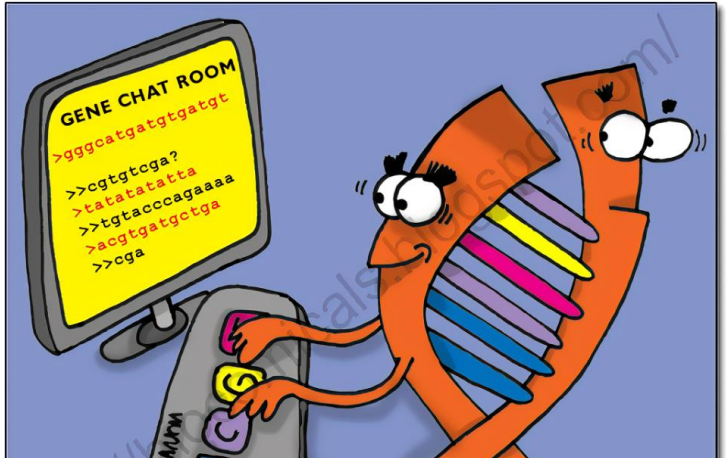
Bioinformatics is where biology and coding meet

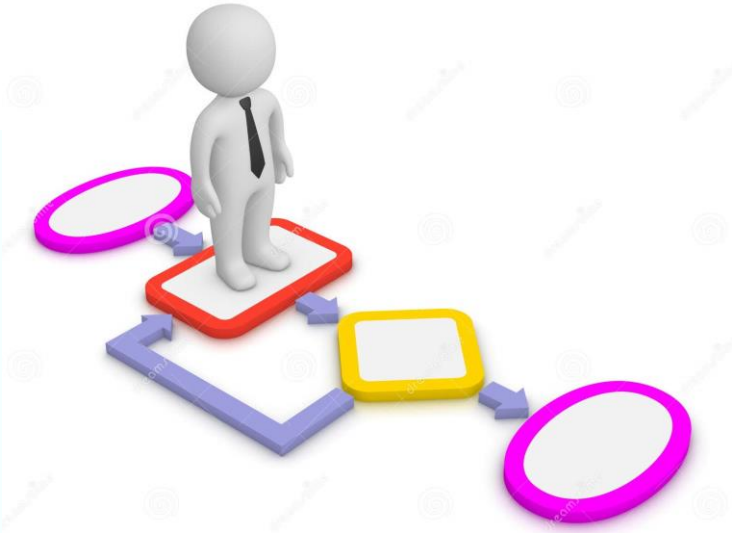
It helps us make discoveries that can **change the world.**

- New ways to treat diseases.
- Insights into how life works at a molecular level.

# WHAT IS USED?

- **Special software** to study life
- Tools to see **inside cells** and **understand diseases**
- **Algorithms** to make **conclusions**



https://jeopardylabs.com/play/introduction-to-bioinformatics-3

# ACTIVITY 6

A jeopardy style review game! You will be put into 3-5 groups, where you will answer questions and earn points based on the difficulty! Whichever group earns the most points recieves awards!

# FUTURE

## FUTURE OF STUDY

How studying bioinformatics could shape your future.

## RANGE OF CAREERS

The wide range of careers that involve bioinformatics, from research scientists to data analysts.

## HOW TO GET INVOLVED

How you can start exploring bioinformatics now: online resources, coding, and biology clubs.

# THANKS

## DO YOU HAVE ANY QUESTIONS?

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