🌿*H2 bio last-minute reminders*

Disclaimer: notes are based on the 2025 syllabus!! These are general guidelines I got from my notes, teachers and friends. Styles of writing may differ from school to school, so please follow your own teachers'/school's guidelines in internal exams. For the actual As…it's kinda up to you lol

FAQs

1. what does it mean by gene mutation in intron can affect binding site of splicing enzymes
    1. Just means the spliceosome can't recognise and bind anymore cause the intron sequences got changed, boundaries changed (complementary base pairing)
2. Does reverse transcriptase synthesise the second dna strand or is it dna pol in virus
    1. DNA pol
3. Does post translational mod happen in proks too or only euk
    1. can happen in proks, but not that significant
4. In telomerase is the new dna on the shortened end synthesised discontinuously or continuous
    1. Continuous (should be) but this ain't important lol

Answering Qns

- "With reference to figure" - quote time, data, aANYTHING to support point even if it's just identifying stages of mitosis must be "anaphase from x min to x min"
- !!!!"Comment" - split into quote data then inferences from data. Or describe structures (in detail!) then LINK structure and function.
- Graph DECREASE/INCREASE GRADUALLY, SHARPLY
- Anytime enzymes are mentioned in whatever topic and context must always say it is complementary in shape and charge to whatever substrate
- LABEL diagram eg when they ask you to draw formation of a dipeptide or any bio molecule, label each monomer, label bond, label WATER
- For any BONDS: specify BETWEEN WHAT AND WHAT eg H bonds BETWEEN CO AND NH GROUPS OF SAME POLYPEPTIDE
- "Describe": NAME the process please. Eg
    - vesicles fuse w membrane , transporting xxx out BY EXOCYTOSIS I know you'd miss this out..
- All drugs eg inhibitors must be stable and not easily broken down so it can remain in active site
- limiting factors? WHAT KIND of limiting factor. HIGH temperature? LOW humidity? Cannot just like "temperature"
- "EVALUATE effect". Cannot say there is an effect or just quote data. Say stuff like INCREASE OR DECREASE, UPREGULATE DOWNREGULATE, WHAT effect it has

- “Suggest why this means this” / “this leads to this” -> explain, then provide a trend. Eg suggest why blood ALT concentration provides measure of damage to liver cells. Because: ALT presence is due to leakage from membranes and cell lysis, and MORE DAMAGE OF LIVER CELLS LEADS TO MORE ALT IN BLOOD.
- Comparison:
    - must compare more in depth eg cannot just be like”virus has RNA dependent RNA polymerase while human cell does not” it must be like human cell has DNA POLYMERASE
    - When comparing different situations when different things bind to same receptor (eg cell sig) must preface by saying “bind PREFERENTIALLY” in whatever scenario.
- Question parts that seem general but turn up as part of a larger question part eg 2020 measles qn - must answer specifically to the context (viruses strain emerging VIRUSES CANNOT EVOLVE AND SPECIATE.)
- !!!!!!!!!TRY NOT TO USE THE WORD “PRODUCING” pleaseee

Carbo

- amylose amylopectin branched: multiple branch ends allow multiple enzymes to work on more sites AT THE SAME TIME increasing energy generation PER UNIT TIME
- If enzyme is added to solution eg amylase added to hydrolyse starch, BIURETS WILL BE POSITIVEEE
- If asked to draw chain, put a bracket outside the molecule and write n
- Glycosidic bond formation is catalysed by enzymes
- always state the observation shown even in SEQ, when it is a negative test do not just write negative test given, eg must say NO BLUE BLACK COLOURATION WHEN STARCH TEST
- Draw a chain and LABEL glycosidic bond
- Set list for comparison
    - monomer
    - type of bond between monomers
    - orientation of monomer
    - Presence of inter chain bonding
    - Structure of molecule
- Benedict’s test for NON REDUCING SUGAR
    - !! CONDUCT BENEDICTS ONCE FIRST then negative result
    - Boil equal volume of new sample of test solution with HCl for ~1min, COOL, add SODIUM BICARBONATE (alkaline medium!!) THEN conduct Benedict’s again.
    - NEGATIVE AT FIRST THEN POSITIVE LATER. this is the whole observation necessary. Cannot conclude from positive alone that non reducing is present.
- Amylase digests a(1-4) not beta I think
- a and b (1,4) whatever doesn’t only refer to glucose monomers. a and b just refers to the orientation of the monomer in the bond. So if they have other app questions like chitin etc I think still just quote the full original bond name 😔😔

Lipids

- no kink if trans bond
- a second role of cholesterol is that it provides mechanical stability due to forming weak hydrophobic interactions
- Always mention PER UNIT MASS eg twice as much energy FOR THE SAME MASS
- Phosphate head is CHARGED NOT POLAR

Proteins

- haemoglobin has no disulfide so that subunits can move wrt each other and cooperative binding
    - Sickle cell is 6th position glutamic hydrophilic changed to valine hydrophobic
- every time mentioning the 4bonds (h, hydrophobic, ionic disulfide) MUST SAY ITS BETWEEN R GROUPS
- Glycine-X-Y but X and Y are only USUALLY proline and hydroxyproline. Which means glycine occurs most frequently (since it's fixed)
- In bio, ionic bond is considered WEAK

Enzymes

- note not ALL enzymes are globular proteins. Some are eg RNA enzymes
- R groups of the catalytic residues are what catalyses conversion (not backbone!!)
- substrate is the one that causes induced fit change
- absorption of thermal energy:
    - Increases kinetic energy more - ALWAYS mention KE whether it's at increasing or decreasing rate
    - FORCEFUL collisions
    - increases frequency of collisions
    - Thermal agitation of ATOMS within the molecules bonds more likely to break
- For denaturation specify which bonds are broken wrt to the contact, catalytic residues etc
    - Temperature: intramolecular vibrations increase
    - Ph: ionic and hydrogen
- Non competitive inhibitors effectively decrease the availability of enzymes as it forms inactive enzyme-inhibitor complexes
- RATE X2 WITH EVERY 10C TEMP INCREASE
- every time there is "explain lowered activation energy" MUST STATE greater proportion of molecules with energy greater than equal to activation energy
- at lower sub conc: enzymes active sites *readily available/ sub conc limiting, increasing sub conc increases frequency of effective collisions
- if explaining why a change in one amino acid causes enzyme activity to decrease - relate amino acid to either part of catalytic or contact/structural residue to explain

- For ALLOSTERIC must always say ALLOSTERIC ACTIVATOR OR INHIBITOR the word ALLOSTERIC MUST APPEAR SOMEWHERE
- For non competitive, SAME Km!!! but diff Vmax (for competitive is lowered Km but SAME VMAX)

Cell Structure

- cm to um x10 000
- um to nm x1000
- Rmb rbc and sex cells which are also eukaryotic don't have a diploid nucleus
- Microtubules made of tubulin which is a dimer
- Size of organelles

Structure	Average length (μm)
Nucleus	5-20
Chloroplast	5-10
Mitochondrion	0.5-1.5
Lysosome	0.2-1.0
Centrioles	0.3-0.5
Ribosome	0.02

Membranes

- cholesterol moves diff speed from phospholipids
- Too high temperatures affects integrity of membrane and resulst in loss of selectivity
- HYDROPHILIC PORE
- Glucose carrier protein
- Some channel proteins may be gated
- active transport is for POLAR MOLECULES AND IONS AND CHARGED STUFF!! non polar against conc gradient ISNT ACTIVE TRANSPORT!!!!!!!!!
- ACTIVE TRANSPORT IN ONE DIRECTION BUT FACIL DIFFUSION CAN BIDIRECTIONAL
- 3 Na+ OUT of cell , 2 K+ INTO cell
- BULK transport: need to mention SUBSTANCES IN LARGE AMOUNTS
- glyco: cell-cell recognition due to diversity. cell receptors.
- advantages of membrane bound: compartmentalisation, increased surface area
- State "by XXX process" eg by ENDOCYTOSIS by EXOCYTOSIS
- Myelin sheath is fatty acid layer (more phospholipids)

- IONS ARE HYDROPHILIC!!! Hence repelled
- Polar— repelled. Large — cannot pass through transient pores

Mitosis & Meiosis

- POLES NOT ENDS OF CELL
- Btw, centromeres CAN DIVIDE regardless of whether spindle forms or not
- CENTROMERES DIVIDE NOT SPLIT
- factors affecting cell division
    - SA: vol
    - nucleuo-cytoplasmic ratio
    - Growth hormones
- Cell checkpoints at G1 G2 and M phase
- Synapsis EARLY Prophase I, crossing over LATE prophase I
- possible arrangements 2^n, n is number of homologous PAIRS
- how mitosis genetic stability
    - dna replication SEMI CONSERVATIVE IDENTICAL
    - Equal distribution !!!of chromosomes SEPARATION DURING ANAPHASE
- It is possible to go to prophase II directly without telophase I and cytokinesis
- When only SOME cells have aneuploidy, it means non disjunction during MITOSIS. cause if it were meiosis then every cell that particular chromosome will be abnormal
- rmb that MUTATIONS give rise to genetic variation too
- Stages: G1 - S - G2 - M

DNA I

- SPAM COMPLEMENTARY BASE PAIRING EVERYWHERE
- Pairing between purine and pyrimidine ensures dna molecule has a constant width of 2.0nm!!!
- semi conservative qns template (usually 1m for describing each gen so see how many total marks!!)
    - MENTION semi conservative
    - Go gen by gen
        - each time state that parental strands unzipped to serve as templates etc etc
    - rmb semi conservative is about 1:separate to serve as template, cbp. 2:each strand is one parent and one daughter
    - Quote data
- ATP needed for unwinding (helicase action)
- prokaryotes no telomeres since dna is circular and has no ends
- nucleoside is the term when excluding phosphate group. Otherwise it's nucleotide. Number of phosphate grps from 1-3
- **Explain the reason for production of Okazaki fragments.**
    - **DNA pol** <u>only works in the 5' to 3' direction</u>

    - Strand extension occurs in direction away form replication fork
    - Synthesis of new strand can only occur in fragments as DNA double helix unzips
- **Draw and label a length of a DNA molecule.** (rmb to include!)
    - Nucleotide
    - Phosphate
    - Deoxyribose
    - Nitrogenous base (write letters too)
    - Phosphodiester bond
    - Show 2 H bonds between A and T; 3 H bonds between C and G

DNA II

- GTP required for translation initiation
- Look for 3'-TAC-5' or 5'-CAT-3' on template strand
- WRITE POLARITY EVERYTIME THEY ASK TO STATE BASES SEQUENCE!!!!!!!!!!!!!!!!!!!!!
- maybe no serious effects of substitution mutation because:
    - 1. degenerate code
    - 2. Amino acid not in critical location
    - 3. Similar aa chem properties
- trna are actly not 100% similar to the non coding dna strand that mRNA is transcribed from cause tRNA has uracil instead of thy
- for sickle cell: MUST MENTION AT LOW O2 CONC ONLY!!
- When describing translation esp in essay, rmb to include amino acid activation

Virus

- infectious viral particle contains at minimum a nucleocapsid
- T4: ds DNA
- lambda: ds DNA
- influenza: 8 segments of ss RNA (-ve strand)
    - 3 of the the segments for RNA DEPENDENT RNA POLYMERASE!!
- HIV: 2 copies of ss RNA
- T4: tail and fibres assembled FIRST before dna head attaches
- anytime "why is xxx needed/ not needed in a virus": FIRST STATE how it is PRESENT OR NOT PRESENT IN THE HOST CELL before saying why xxx is needed by virus
- Always name the type of cycle first eg lytic cycle or lysogenic
- In lysogenic, it is incorrect to say phage dna is not transcribed at all - repressor proteins are from phage genome!!
- INSERTIONAL MUTAGENESIS. (Retroviruses)

Bacteria

- for operons

    - what binds to what (corepressor, co activator) ALLOSTERIC SITE
    - conformational change
    - Stabilise active/inactive state
    - Binds to what at DNA BINDING SITE! At operator/ promoter
    - Rna pol can/cannot bind
    - Hence operon is WHAT (on/off)
- It is possible for plasmid to be integrated in the bacterial chromosome and not just be outside
- NOTE‼ binary fission is NOT nuclear division it's a form of cell division only (bac no nucleus)
- For transformation, must first say: bac cell is competent or not!!
- for all methods: must state ALLELES ARE EXPRESSED RESULTING IN CHANGE IN PHENOTYPE

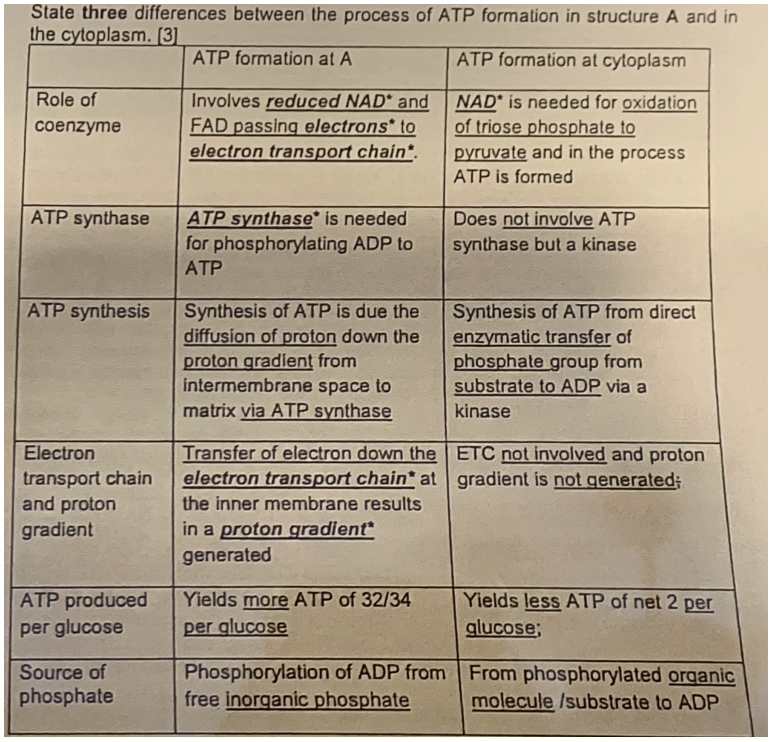
Prok-Euk

- post translation control allows for fast activation of the proteins to respond to changes if not the protein needs to be translated and everything from SCRATCH
- prok genome only has one ori of replication but euk has MANY
- poly A tail is degraded 3' to 5'‼‼‼
- template ans
    - more/less tight binding dna and histone (mention ELECTROSTATIC ATTRACTION for histone acetylation!!!)
    - Increase/decrease accessibility to gtf and rna pol
    - Promote/inhibit TIC formation
- mention specific transcription factors along with activators/ repressors. Say "specific transcription factors, activators, bind…" and not "activators bind…"
- Post trans mod can only happen after trans is done, even tho 5 cap added while transcr
- apoptosis NOT THE SAME as cell death!! cell death due to toxins and stuff
- Alternative splicing doesn't give rise to a fixed number of protein iso forms. It gives rise to a wide variety so you can't say diff protein iso forms eg for globin gene are expressed because of alt splicing
- If asked to draw mature mRNA REMEMBER TO DRAW CAP AND TAIL!!
- (Relevant to stem cells as well) rmb that more permanent differentiation gene regulation is by GENE METHYLATION that kinda thing. Binding repressors/activators is more of upregulation downregulation.
- Telomeres also prevent chromosome degradation by nucleases (so ig chromosomes are actually degraded by nucleases…)
- ‼‼FOR TELOMERES MUST ALWAYS MENTION NONCODING TANDEM REPEATS.
- Always write these together ya
    - LOSS OF FUNCTION in tumour suppressors
    - GAIN IN FUNCTION MUTATION in proto-oncogenes
- Tumour cells are genetically identical

- Gain in function and loss in function are not risk factors for developing cancer. They are HOW cancer develops
- **Explain why the mitotic cell cycle must be tightly regulated**
    - This is to allow for checkpoints to check that there is no DNA damage or mutations in the cell before the cell is allowed to proceed to the next stage of the cell cycle
    - If there are mistakes in the DNA they need to be repaired otherwise there will be accumulation of mutations in the daughter cells (NOT genetic variation)
    - This would lead to uncontrolled cell division causing a tumour to form and resulting in cancer
    - Note checkpoints do not reduce or prevent mutations!! They check that mistakes in replication are repaired. Don't mention genetic variation, this is MITOSIS.

Respiration

- for explaining why OP cannot occur without oxygen
    - No o2 as final e acceptor
    - **NADH cannot be oxidised
    - **e carriers remain reduced, electron transport does not occur, no proton motive force generated
    - Must mention both points
- NO net change in NAD and NADH
    - NAD continuously accepting e during glyco, link and Krebs to form NADH
    - NADH continuously reoxidised during op to NAD



State **three** differences between the process of ATP formation in structure A and in the cytoplasm. [3]

	ATP formation at A	ATP formation at cytoplasm
Role of coenzyme	Involves ***reduced NAD**** and FAD passing ***electrons**** to ***electron transport chain****.	***NAD**** is needed for oxidation of triose phosphate to pyruvate and in the process ATP is formed
ATP synthase	***ATP synthase**** is needed for phosphorylating ADP to ATP	Does not involve ATP synthase but a kinase
ATP synthesis	Synthesis of ATP is due the diffusion of proton down the proton gradient from intermembrane space to matrix via ATP synthase	Synthesis of ATP from direct enzymatic transfer of phosphate group from substrate to ADP via a kinase
Electron transport chain and proton gradient	Transfer of electron down the ***electron transport chain**** at the inner membrane results in a ***proton gradient**** generated	ETC not involved and proton gradient is not generated;
ATP produced per glucose	Yields more ATP of 32/34 per glucose	Yields less ATP of net 2 per glucose;
Source of phosphate	Phosphorylation of ADP from free inorganic phosphate	From phosphorylated organic molecule /substrate to ADP

Suitability of ATP as Energy source. Why universal

- found in most living things as immediate energy source
- Small diffusible water soluble
- High turnover, converted to ADP and Pi and back
- INTERMEDIARY between energy requiring and energy yielding reactions (catabolic and anabolic)
- Produced in a variety of processes eg op and substrate level.

Photosynthesis

- cannot just say “co2 used during photosynthesis” must be like “co2 FIXED during the LIGHT INDEPENDENT STAGE of photo”
- RuBP is the CARBON DIOXIDE ACCEPTOR
- Calvin cycle: during reduction and regeneration, ATP used isn’t directly for reduction like it’s not oxidised or anything — ATP is just the energy source

Genetics

- “dominant allele masks recessive allele” ❌‼ “GENE PRODUCT of dominant masks EFFECT OF GENE PRODUCT of recessive”‼
- Test cross: to reveal the genotype of an organism that exhibits DOM trait (by crossing with homo recessive)
- 2:1 mod ratio implies lethal alleles (the organism that dies, its phenotype is not counted)
- Write characteristics — “bent TAIL” “normal TAIL” and if sex linked include gender “bent TAIL FEMALE” “normal TAIL MALE”
- Epistasis is a form of gene interaction in which a gene at one locus alters the phenotypic expression of a gene at a second locus.
- Explain what epistasis means template
    - Genotype A_ codes for (xxx, enzyme, inhibitor whatever) that (function)
    - Genotype B_ codes for production of… same as above
    - Genotype A_ masks the expression of B/b locus -> changes accord to qn
    - Thus inhibitor will result in… regardless of B/b
- Continuous variation is always effect of many genes, but may not always be affected by env
- Carrier / heterozygous is NOT a phenotype
- Explain why range of PHENOTYPES- due to additive effects of gene, polygenic inheritance, affected by env factors, continuous variation
- Explain why GREATER range of VARIATION in F2– due to crossing over, random fertilisation

Cell signalling

- within the relay proteins signal transduction pathway, phosphorylation does NOT ALWAYS MEAN ACTIVATION , sometimes proteins can be deactivated
- G protein coupled receptor
    - Before activation, G protein is NOT bound to the receptor. Only after ligand binds and receptor activated, receptor binds to inactive G protein to activate it
    - Second messengers: speed monsters
- How to allow permanent response (possible qn type):
    - Anyhow say bruh but just target either:
    - Receptor (something binds to receptor, making it permanent binding to ligand)
    - Enzyme eg adenylyl Cyclase (something binds to enzyme, make it continuously active)
    - Adjust according to context but generally can use these two
- Second messengers DO NOT AMPLIFY SIGNAL. One to one. Only enzymes amplify.
- CANNOT use “competitive inhibitor” just say bind and block.
- (Link to cancer) must say ACTIVE PRODUCTION/ACTIVATED EVEN WHEN LIGAND NOT BOUND. EVEN WHEN LIGAND NOT BOUND TO SITE.

MBT

- basis for high accuracy of PCR is cbp by PRIMERS. cannot write taq polymerase – complementary base pairing because taq has no proofreading
- For comparing PCR fingerprinting identify people: the (top two) bands of this sample are of the same MOLECULAR SIZE as the ones in that sample — corresponding
- **Explain why the individual suffers from the disease even though screening using RFLP marker identified him only as a carrier.**
    - During formation of gametes in (individual name)
    - Crossing over could have occurred at a locus between the disease allele and RFLP marker such that the disease allele became linked to RFLP allele (state which allele as given in qn)
    - The individual hence inherited two copies of the disease allele.
    - Note: this is a limitation when studying RFLPs flanking the disease allele, however the crossover frequencies tend to be very low as RFLP lie close to the gene of interest
- **PCR vs DNA replication.** (criteria)
    - Only a target replicated vs entire thing
    - Proofreading (yes vs no)
    - Separation of strands (heat vs helicase)
    - Primer type (DNA primer, ss, anneals at temp.s in a pair vs RNA primer, no need pairs)
    - Primers (synthetic vs synthesised by primase)
    - Type of enzyme (Taq pol vs DNA pol)
    - Temperature (list changes, vs relatively stable at 37C body temp)

- **PCR and DNA replication** (similarities)
    - Separate two strands to serve as template
    - Complementary base pairing
    - Bonds (phosphodiester)
    - Products (both DNA product)
    - 5’ to 3’ synthesis

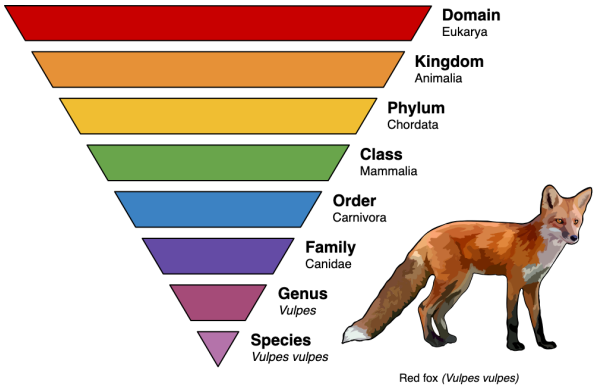
Stem cells

- trophoblast: outer layer of blastocyst, develops into placenta and other supporting tissues. Cannot have a whole organism without this part
    - Inner area is the blastocyst cavity (fluid with signals for differentiation)
- Progenitor cells CANNOT self renew.
- “List characteristics of xxx stem cells” - list the usual few characteristics of stem cells (undiff, unspecialised, able to specialise upon…, and the potency of that particular stem cell)
- EXTENSIVE proliferation comes tgt with by MITOSIS

Evolution

- Evo def: descent with mod from a common ancestor
- ALLELES are lost from gene pool not GENES.
- Homologous structures sample
    - 1. Shared feature (state what feature) modified to perform different functions
    - 2. Descent with mod from common ancestor
    - 3. Due to diff selection pressures
- Natural selection sample
    - 1. Why variation- MUTATIONS. State mutation.
    - 2. State selection pressure
    - 3. These ancestral (XXX) survived and reproduced passing on their ALLELES conferring “..” ability
    - 4. Overtime change in ALLELE FREQ
- !!MUTATION— MUST BE IN SEX CELLS!! IF IN SOMATIC, IT WONT BE PASSED ON!!!
- “How it supports Darwin’s theory of evolution” —> MENTION NATURAL SELECTION.. spam it somehow??
- “Islands are geographically isolated…” BY WATER! ALWAYS MENTION WATER THAT ACTS AS PHYSICAL BARRIER preventing interbreeding
- !!!!How speciation occurs/allopatric
    - 1. GEOGRAPHICALLY ISOLATED + DISRUPTION of GENE FLOW
    - 2. DIFFERENT NICHES, DIFFERENT SELECTION PRESSURES
    - 3. underwent evolutionary changes independently, different genetic MUTATION, different alleles freq change, GENETIC DRIFT AND NATURAL SELECTION

    - 4. REPRODUCTIVELY ISOLATED and NO LONGER INTERBREED to produce FERTILE VIABLE.
- Heterozygote advantage: mention selected AGAINST for both other genotypes!!! (Homo recessive and dominant) it's a keyword!! Then selected FOR for the hetero!
- Advantages of Latin name
    - Universal name AVOID AMBIGUITY
    - can identify organism then classify it, ORGANISE INTO GROUPS/TAXONS
- DNA yields more genetic info than RNA because degeneracy of genetic code, some nucleotide differences may not be reflected in amino acids sequences



pic credits(wikipedia)

Infectious Diseases

- CLASS SWITCHING IS INDUCED BY T CELLS
- If some antibody level only appears after the infection with actual pathogen and not after vaccine, it's because this antigen was not in the vaccine
- Chemokines recruit neutrophils. Cytokines increase permeability of blood vessels

Climate Change

- Zooxanthellae are expelled by coral, they don't leave of their own accord.. 😔😔 when the corals are heat stressed, they expel the zooxanthellae.

Practical notes

How to make experiment valid:

- 5 or more IV (state name) at equal intervals
- Repeats, replicates and average
- Take samples at same time interval
- Same volumes or concentration, volume of starch, amylase etc

Limitations of experiment

- before anything else, can say there is limited range of reactant concentrations (usually only if expt gave less than 5…?)
- Only two replicates, hence anomalies not fully identified

Control:

- confirm ❌ ensure ❌
- “Shows”!!

Bar chart MUST HAVE VALUES LABELLED ON TOP OF EACH BAR.