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87702540

OVERMUGGED@GMAIL.COM

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UPPER SECONDARY IP BIOLOGY

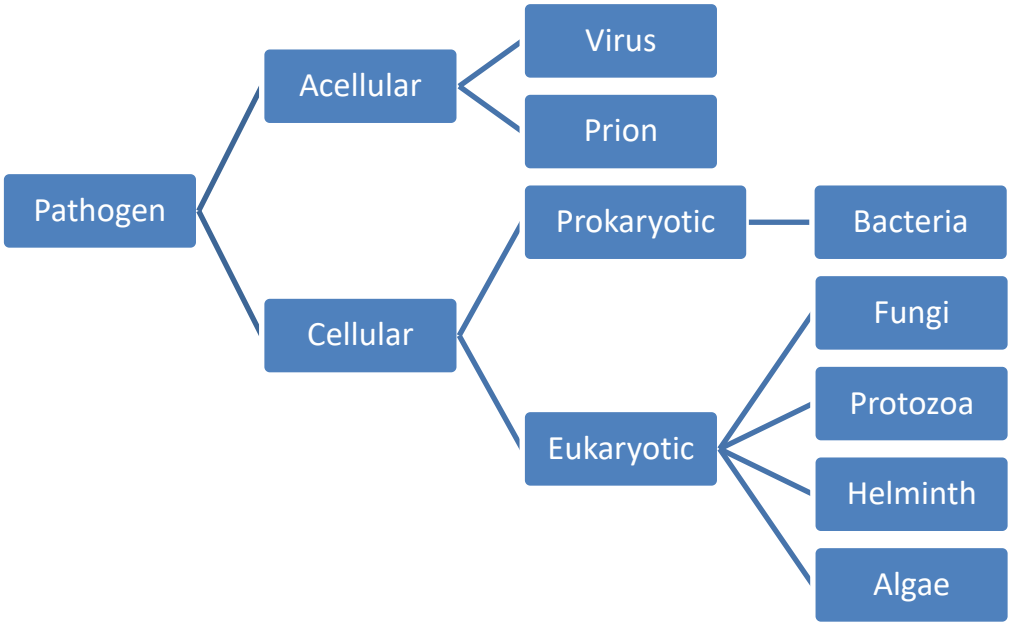
Infectious Diseases in Humans

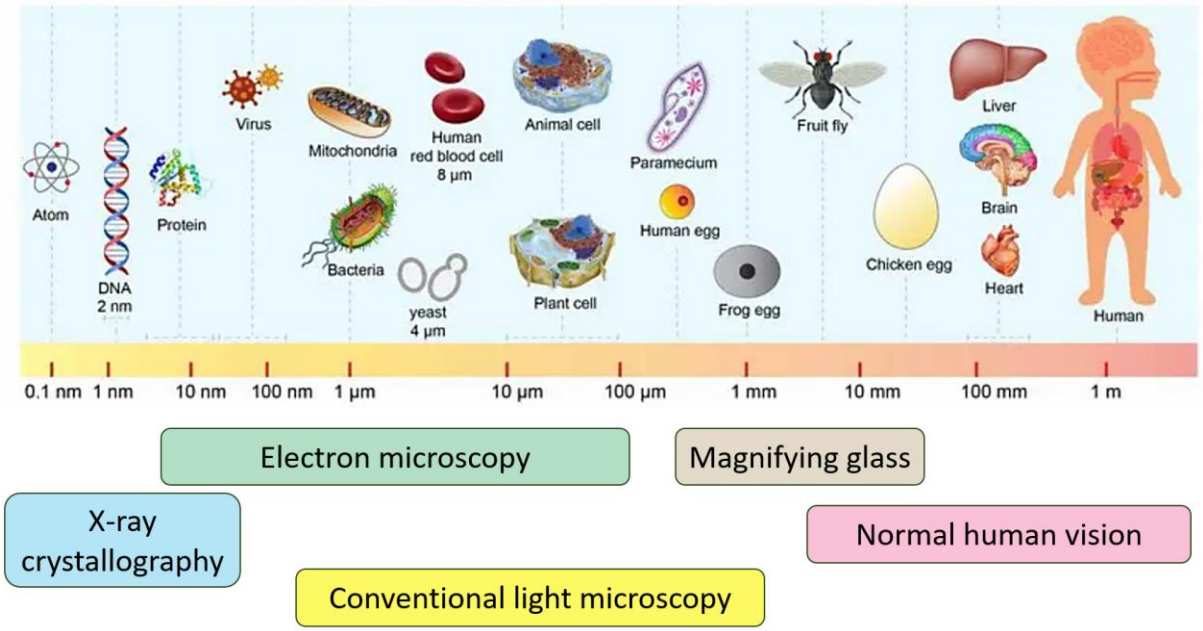
NYGH S3 WA2 Revision

Name: _____

Date: _____

What are pathogens?





Prion diseases

All cell membranes have proteins embedded within for a variety of functions. Prions form when proteins in the brain misfold or mutate into different structures and conformations. These abnormal proteins cause prion diseases (also known as transmissible spongiform encephalopathy, TSE) that are transmissible and unfortunately, untreatable.

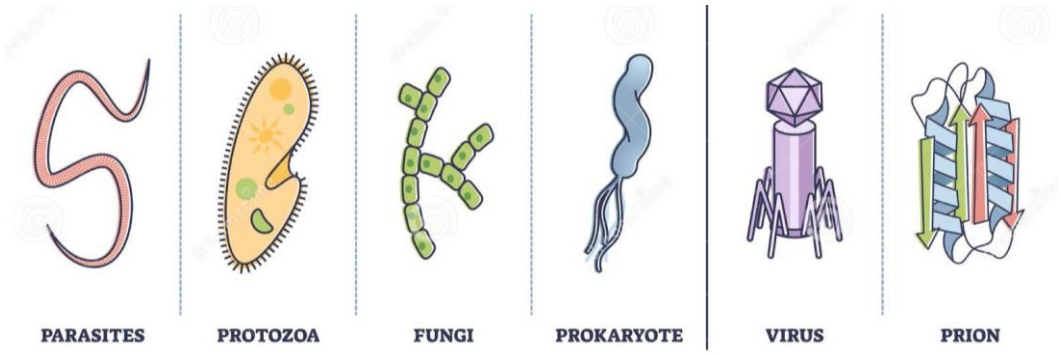
Some studies have hypothesised that these abnormal proteins may bind to and induce other proteins to also undergo a conformational change. This could result in a chain reaction that propagates the growth of prions and accelerates the progression of the diseases it causes.

Prion diseases are rare, affecting approximately 0.0002% of the global population yearly, and are either inherited or acquired. However, prion diseases may even occur without inheriting a genetic muation or exposure to prion infections.

Prion disease	Characteristics
Creutzfeldt-Jakob Disease (CJD)	🧠 Severe, rapid onset, fatal 🧠 Cognitive impairment 🧠 Muscle atrophy 🧠 Personality changes
Kuru	🧠 Non-immunogenic 🧠 Arose from ritualistic consumption of tissues from recently deceased family members (including the brain) 🧠 Loss of bodily control 🧠 Behavioural changes 🧠 Random compulsive laughing or crying
Bovine Spongiform Encephalopathy (BSE)	🧠 “Mad Cow disease” 🧠 Abnormal posture 🧠 Coordination problems and difficulty in rising 🧠 Decreased milk production

Mad Cow disease: https://youtu.be/Pxojz6grwcU

Pathogens



Pathogen	Characteristics
Parasitic worm/helminth	• Worm-like parasite • Invertebrates with elongated, flat, or round bodies • Complex life cycle involving hosts Helminths: Intestinal Nematodes: https://youtu.be/O1qf3R3zMB0 Colonoscopy Demonstrating a Moving Worm | NEJM: https://youtu.be/AZr36qP14p4
Protozoa	• Unicellular eukaryotes • Individual organisms or parasitic • Motile via use of flagella, pseudopodia, or cilia
Fungi	• Eukaryotic • Unicellular (yeast) and multicellular (mushrooms, molds) • Absorb nutrients from immediate surrounding
Prokaryote	• Cells without endomembrane systems • Short generational times result in overwhelming infection rates • Adapt to host immune system defenses quickly Anthrax: https://youtu.be/vVD5QtVmC8s
Virus	• Smallest (20 – 400 nm) • Single or double-stranded nucleic acids surrounded by a protein coat • Requires a host to reproduce using host cell machinery • Specific to target cells
Prion	• Mutated cell protein with abnormal structure • Cause neurodegenrative diseases • No cure

What's this disease?

You're an aspiring epidemiologist tasked with caterogising some diseases. Do some research to identify a disease caused by each pathogen type discussed today. Also include the scientific name of the causative agent, the mode of transmission, and how it affects the host. Consolidate your findings in the table below.

Pathogen	Disease	Scientific name of pathogen	Mode of transmission	How it affects the host
Parasitic worm/helminth				
Protozoa				
Fungi				

Pathogen	Disease	Scientific name of pathogen	Mode of transmission	How it affects the host
Prokaryote				
Virus				
Prion				

Share your findings with your colleagues. Let's hope to uncover as many different diseases together as possible!

The Deadliest Virus on Earth: https://youtu.be/4u5I8GYB79Y

The Most Horrible Parasite: Brain Eating Amoeba: https://youtu.be/7OPg-ksxZ4Y

The Most Gruesome Parasites – Neglected Tropical Diseases – NTDs https://youtu.be/qNWWrDBRBqk

Write your answers in the table below.

1	2	3	4	5	6	7	8	9	10

Question 1

Which of the following is not an infectious disease?

(A) COVID-19

(B) AIDS

(C) Dengue fever

(D) Diabetes

Question 2

What can viruses also be classified under?

(A) A pathogen

(B) A fungus

(C) A bacterium

(D) A protist

Question 3

Which of the following diseases is transmitted by bacteria?

(A) Influenza

(B) HIV

(C) Tuberculosis

(D) Kuru

Question 4

Which of the following is not a symptom of pneumococcal disease?

(A) High fever

(B) Chest pain

(C) Stiff neck

(D) Swollen eyes

Question 5

Sally was sadly down with a viral infection. Her mother tried the following treatments on her.

I. A week's dose of antibiotics
II. Taking off-the-shelf medication for sore throat
III. Resting in bed more
IV. Having Sally take a cold shower

Which treatment(s) helped Sally recover faster?

(A) I and II only

(B) II and III only

(C) I and III only

(D) I, III, and IV

Question 6

George suggested four possible ways to make vaccines using viruses.

I. Live and attenuated
II. Original virus
III. Inactivated
IV. Partial structure of the original virus

Which option would result in an unsafe vaccine?

(A) I and II

(B) II only

(C) II and IV

(D) III and IV

Question 7

Which vaccine type would confer the longest lasting immunity to a disease?

(A) Live and attenuated

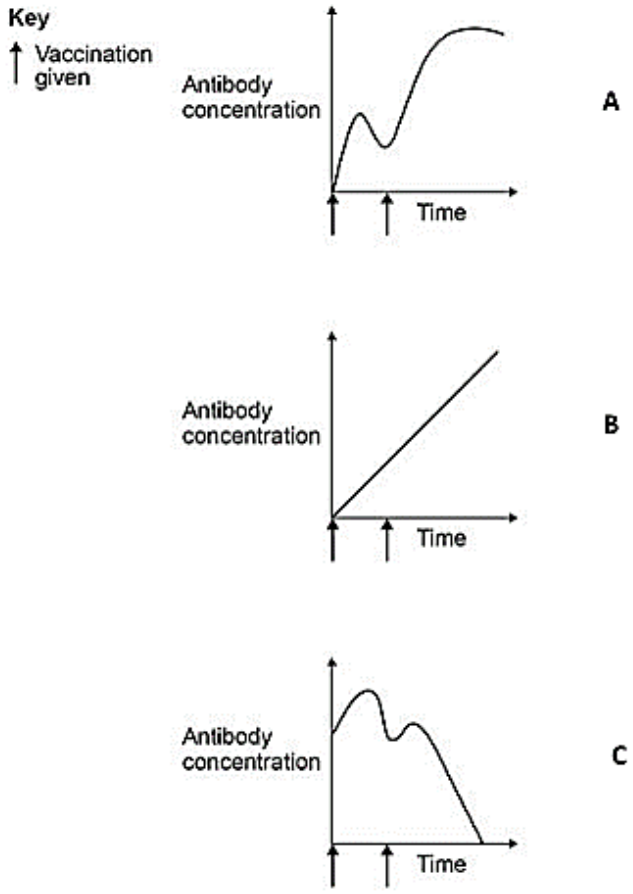
(B) Original virus

(C) Inactivated

(D) Partial structure of the original virus

Question 8

The graphs below show how the antibody concentration may change following a vaccination.



Which graph correctly explains why some vaccines require multiple doses?

(A) Graphs A and B

(B) Graph A only

(C) Graphs B and C

(D) Graph C only

Question 9

What should people do to combat antibiotic resistance?

(A) Only share antibiotics within the immediate family

(B) Use leftover antibiotics for future illnesses to save costs

(C) Only take antibiotics when prescribed and complete the stated course

(D) Take double the dosage to kill the bacteria more effectively

Question 10

After an all-night study party, Andy fell really sick and was hospitalised with a new type of disease. To establish the way in which the pathogen was spread, Andy described to the doctor some of the events that he recalled from the party.

I. He shook the hand of an old friend who he had not seen in years.
II. He was standing close to someone who was constantly coughing.
III. He drank a beverage from an unknown cup that was on the table.
IV. He ate a piece of chilli chocolate candy that was individually wrapped.

Which event(s) could have led to Andy being infected by another person?

(A) I and III only

(B) II and IV only

(C) I, III, and IV

(D) I, II, and III

Write your answers in the spaces provided.

Question 11 [CCHS (Y) 2022 S4 Prelim P1 | Q6 - modified]

Doctors were investigating the spread of the varicella zoster virus that results in chickenpox, producing spots throughout the body.

One day after a birthday party where 23 children were present, one child developed chickenpox spots. Doctors then contact-traced all the parents and asked them to record when their child first showed the chickenpox spots.

Day when chickenpox spots first appeared	Number of children
4	0
6	0
8	0
10	1
12	1
14	6
16	4
18	2
20	0
Total	**14**

(a) What was the range of days for children to first show chickenpox spots? [1]

From day _____ to day _____ .

(b) Incubation time refers to the duration from exposure to a pathogen to when symptoms first appear. Suggest the most likely incubation time for chickenpox. [1]

_____

(c) Upon realising her child had chickenpox, a concerned mother quickly found some leftover antibiotics and had her child take it.

Suggest why her child did not recover any faster than the other children. [2]

_____

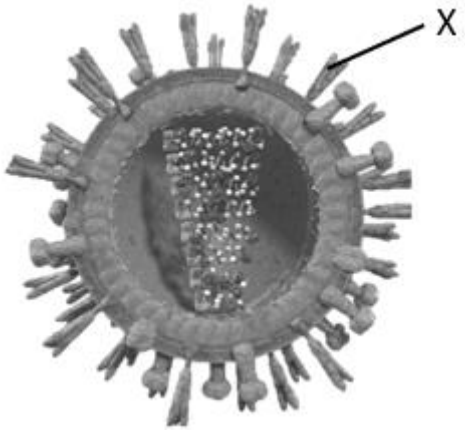
_____

_____

_____

Question 12

A cross section of an enveloped virus is shown below.



(a) Identify structure X and state its function. [2]

(b) In all eukaryotic cells, mitochondria oxidise glucose to release chemical energy for the cell to function.

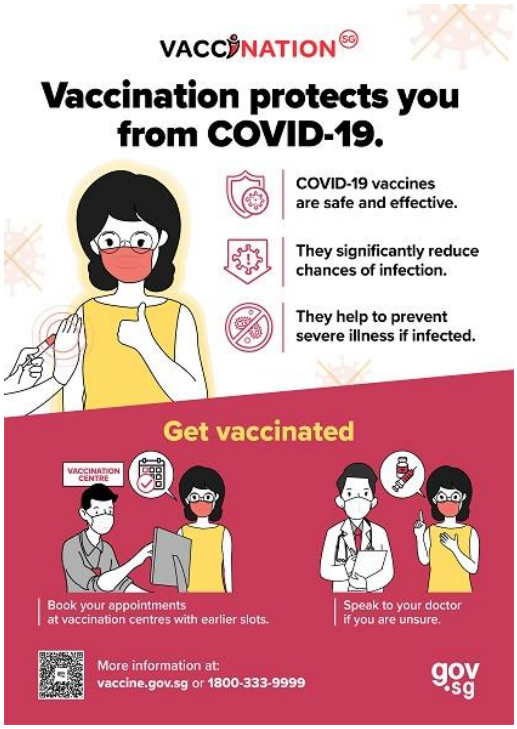
Based on the above information, and your knowledge about cells, suggest why viruses cannot survive without a host. [2]

(c) A typical influenza vaccine is made using structure X. Due to the high rate of mutation of the influenza virus, the structure of X often changes after about 1 year.

Suggest why individuals who have taken an influenza vaccination can still contract influenza a year later. [2]

Question 13

A poster was made to help encourage Singaporeans to vaccinate as quickly as they can was made by the local government.



(a) Explain why vaccines do not prevent infection entirely but rather "significantly reduce the chances of infection". [2]

(b) (i) Describe the key components of a virus vaccine and how it resembles a pathogen. [2]

(ii) Explain the role of white blood cells in the immune response stimulated by vaccines. [2]