

Culturing and measuring microorganisms

What is the purpose of aseptic technique?

Culturing and measuring microorganisms

Why is an inoculating loop heated until red hot and then cooled before use?

Culturing and measuring microorganisms

Why are plate lids taped with short strips only, and not sealed all round?

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How is a culture medium sterilised in the laboratory?

Culturing and measuring microorganisms

What is a colony-forming unit (cfu)?

Culturing and measuring microorganisms

How is the number of cfu per cm³ of the original culture calculated?

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Which method of measuring microbial growth counts only living cells?

Culturing and measuring microorganisms

Why is dry mass a better measure than wet mass?

Red hot kills microorganisms on it. Cooling stops it killing the culture being transferred.

To stop unwanted microorganisms contaminating a culture and to stop the cultured organisms escaping or infecting the worker.

In an autoclave: steam at 121 °C under pressure for at least 15 minutes.

So oxygen can still enter and anaerobic pathogens are not selected for.

$(\text{Colonies} \div \text{volume plated in cm}^3) \times \text{dilution factor}$

A single living cell or small clump of cells that grows into one visible colony on agar.

Wet mass includes a variable amount of water.

Dilution plating (a viable count).

Culturing and measuring microorganisms

How does turbidity change as a culture grows, and what instrument measures it?

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Name the four phases of the bacterial growth curve.

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What is happening to the cells in the lag phase?

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Why does the growth curve level off in the stationary phase?

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Write the formula for the number of generations (n).

Culturing and measuring microorganisms

What is the exponential growth rate constant (k)?

Culturing and measuring microorganisms

Which variables are controlled in core practical 13?

Culturing and measuring microorganisms

Why must only non-pathogenic strains be used in school culturing?

Lag phase, exponential (log) phase, stationary phase, death phase.

It rises, as more cells scatter light. A colorimeter records absorbance.

Nutrients become limiting and waste builds up, so the rate of division equals the rate of death.

They adjust to the medium, take up nutrients and make enzymes. Little division occurs.

The number of generations per unit time in the exponential phase: $k = n \div t$.

$$n = (\log_{10} N_t - \log_{10} N_0) \div 0.301.$$

Samples could otherwise contain harmful pathogens. Safe strains such as yeast or E. coli K12 are used.

Volume and type of broth, starting cell density, strain, temperature (or the variable not being tested), aeration and timing of readings.

Culturing and measuring microorganisms

How is the rate of growth found from a graph of absorbance against time?

Bacteria, viruses and infection

What is a capsid?

Bacteria, viruses and infection

Which of Ebola, TMV, HIV and lambda phage have an envelope?

Bacteria, viruses and infection

Which nucleic acid does each of these viruses have: HIV, TMV, lambda phage?

Bacteria, viruses and infection

Which organisms do TMV and lambda phage infect?

Bacteria, viruses and infection

What is the lytic cycle?

Bacteria, viruses and infection

What is latency?

Bacteria, viruses and infection

What is a provirus?

The protein coat made of subunits that surrounds the nucleic acid of a virus.

The gradient of the exponential section, or of a tangent drawn to the curve.

HIV: single-stranded RNA. TMV: single-stranded RNA. Lambda phage: double-stranded DNA.

Ebola and HIV. TMV and lambda phage do not.

A cycle in which a virus replicates at once inside the host cell, making many new virus particles, and the cell bursts.

TMV infects plants (tobacco). Lambda phage infects bacteria (E. coli).

HIV DNA, made from RNA by reverse transcriptase, integrated into the host chromosome.

Viral nucleic acid persists in the host cell without producing new virus, often integrated into the host DNA.

Bacteria, viruses and infection

How does Mycobacterium tuberculosis avoid destruction by macrophages?

Bacteria, viruses and infection

What is a tubercle?

Bacteria, viruses and infection

Which cells does HIV infect, and which receptor does it bind?

Bacteria, viruses and infection

What does reverse transcriptase do?

Bacteria, viruses and infection

Why do people with HIV die?

Bacteria, viruses and infection

Name the major routes by which pathogens enter the body.

Bacteria, viruses and infection

How does stomach acid protect against infection?

Bacteria, viruses and infection

How do gut flora protect against pathogens?

A ball of macrophages, T cells and dead tissue formed around TB bacteria in the lungs.

It prevents lysosomes fusing with the phagosome and has a waxy cell wall, so it survives and multiplies inside.

Makes a DNA copy from the viral RNA genome.

Helper T cells (and some macrophages), by binding the CD4 receptor with gp120.

Gas exchange system, digestive system, breaks in the skin, mucous membranes (genital tract, eye), and across the placenta.

Helper T cells are destroyed, the immune system fails, and opportunistic infections such as TB cause death.

They compete for nutrients and space and make substances that inhibit pathogens.

Hydrochloric acid at pH 1 to 2 kills most pathogens in food and drink.

Bacteria, viruses and infection

How does the skin protect against infection?

The immune response

Describe the steps of inflammation.

The immune response

What does lysozyme do?

The immune response

What does interferon do?

The immune response

Steps of phagocytosis in order.

The immune response

Define antigen.

The immune response

Describe the structure of an antibody.

The immune response

What is an antigen-presenting cell?

Histamine released, vasodilation and more permeable capillaries, tissue fluid causes swelling, phagocytes attracted to the site.

A keratinised physical barrier, acidic sebum, skin flora competing with pathogens, and blood clotting at cuts.

Released by virus-infected cells; stops viral protein synthesis and mRNA in neighbouring cells.

Hydrolyses peptidoglycan in bacterial cell walls, causing lysis by osmosis.

A molecule, usually protein or glycoprotein, recognised as foreign that stimulates an immune response.

Binds, engulfed into a phagosome, lysosome fuses, enzymes digest, antigens presented.

A cell that displays foreign antigen on its surface to T cells, for example a macrophage.

Y-shaped; two heavy and two light chains; disulfide bridges; variable regions form two antigen-binding sites; constant region and hinge.

The immune response

How do antibodies help destroy pathogens?

The immune response

What does a T helper cell do?

The immune response

What does a T killer cell do?

The immune response

What is the difference between a plasma cell and a B memory cell?

The immune response

Why is the secondary immune response faster?

The immune response

Define artificial active immunity.

The immune response

Give examples of natural passive immunity.

The immune response

Why is passive immunity short-lived?

Is activated by an antigen-presenting cell and releases cytokines that activate B cells and T killer cells.

Agglutination, opsonisation for phagocytosis, neutralising toxins and blocking attachment.

Plasma cell (B effector) secretes antibodies. B memory cell is long-lived and gives a fast response to the same antigen.

Kills infected body cells by releasing perforin and enzymes.

Immunity from vaccination: the body makes its own antibodies and memory cells.

Memory cells are already present and divide quickly into plasma cells.

No memory cells are formed and the antibodies are gradually broken down.

IgG across the placenta and IgA in colostrum and breast milk.

The immune response

What is the evolutionary race between pathogens and hosts?

The immune response

Give three ways pathogens evade the immune system.

The immune response

Why is influenza vaccine updated regularly?

Antibiotics and infection control

What does bactericidal mean?

Antibiotics and infection control

What does bacteriostatic mean?

Antibiotics and infection control

How does penicillin kill bacteria?

Antibiotics and infection control

Why do antibiotics not work on viruses?

Antibiotics and infection control

Core practical 14: how is the effect of antibiotics compared?

Antigenic variation, hiding inside host cells, and destroying or disabling immune cells.

Continued selection of pathogen mutations that evade immunity and host variations that resist, each driving change in the other.

Kills bacteria.

Surface antigens change by mutation, so memory cells for the old strains do not recognise new strains.

It prevents cross-links forming in the peptidoglycan wall, so the cell bursts by osmosis.

Stops bacteria growing and dividing without killing them.

Measure the zones of inhibition around discs on a bacterial lawn. A bigger zone means more effective.

Viruses have no cell wall or ribosomes of their own and replicate inside host cells.

Antibiotics and infection control

Why is a control disc without antibiotic used?

Antibiotics and infection control

How is the area of a zone of inhibition calculated?

Antibiotics and infection control

Give two safety precautions when culturing bacteria in school.

Antibiotics and infection control

What is a hospital-acquired infection?

Antibiotics and infection control

Why does overuse of antibiotics cause resistance?

Antibiotics and infection control

Give three codes of practice that reduce hospital infection.

Decay, DNA techniques and forensics

What type of nutrition do decomposers have?

Decay, DNA techniques and forensics

How do decomposers return carbon to the atmosphere?

Area = πr^2 , with r half the measured diameter.

To show that the disc and solvent do not affect bacterial growth.

An infection acquired in hospital, for example MRSA or C. difficile.

Non-pathogenic strain; incubate at 25 °C; tape lids and do not open after incubation; autoclave.

Hand washing, isolation of infected patients, sterilising equipment, screening, careful antibiotic prescribing.

It selects for bacteria with resistance mutations, which survive and reproduce.

They respire the absorbed organic compounds, releasing CO₂.

Saprotrophic: extracellular digestion then absorption.

Decay, DNA techniques and forensics

Which conditions speed up decomposition?

Decay, DNA techniques and forensics

What is PCR used for?

Decay, DNA techniques and forensics

What is the role of primers in PCR?

Decay, DNA techniques and forensics

Why is Taq polymerase used?

Decay, DNA techniques and forensics

Temperatures and steps of a PCR cycle.

Decay, DNA techniques and forensics

Why does DNA move towards the anode in electrophoresis?

Decay, DNA techniques and forensics

Which fragments move furthest through the gel?

Decay, DNA techniques and forensics

What is the purpose of a DNA ladder?

Amplifying (copying) a specific sequence of DNA from a small sample.

Warmth, moisture, oxygen and a suitable pH.

From *Thermus aquaticus*; heat-stable, so not denatured at 95 °C.

Short single-stranded DNA sequences complementary to the ends of the target, from which Taq polymerase starts.

Phosphate groups make it negatively charged.

95 °C denaturation, 55 to 65 °C annealing, 72 °C extension.

Fragments of known lengths, used to estimate the lengths of sample fragments.

The shortest fragments.

Decay, DNA techniques and forensics

What does DNA profiling compare?

Decay, DNA techniques and forensics

How is DNA profiling used to show paternity?

Decay, DNA techniques and forensics

Give two other uses of DNA profiling.

Decay, DNA techniques and forensics

Why does the body cool after death?

Decay, DNA techniques and forensics

Why does rigor mortis occur?

Decay, DNA techniques and forensics

What is forensic entomology?

Decay, DNA techniques and forensics

What is succession on a dead body?

Every band in the child must come from the mother or the father; bands not in the mother must be in the father.

The number of short tandem repeats in non-coding DNA, shown as a pattern of bands.

Metabolism stops, so heat is no longer made and the body cools towards the temperature of its surroundings.

Forensic identification of suspects; identifying species or individuals; relatedness in breeding programmes.

Using the species and development stage of insects, such as blowfly larvae, on a body to estimate time of death.

ATP is not made, so myosin heads cannot detach from actin.

Different species colonise in a sequence as the body decomposes.