Biology

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Contents

Preface

This is a live document, and is full of gaps, mistakes, typos etc.

Part I

DNA

Chapter 1

Proteins

1.1 Introduction

Chapter 2

DNA

2.1 Introduction

2.1.1 Deoxyribonucleic acid (DNA)

DNA contains nucleotides.

There are 4 types of nucleotides, which differ depending on their nucleobase:

+ Cytosine (C); + Guanine (G); + Adenine (A); and + Thymine (T).

2.1.2 Ribonucleic acid (RNA)

Part II

Cells

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Abiogenesis

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Single-celled organisms

4.1 Components prokaryotic cells

4.1.1 Nucleiod

This contains the DNA molecule.

4.1.2 Cell membrane

A cell membrane separates the insides of cell from the environment.

Membranes are selectively permeable to compounds.

4.1.3 Cytoplasm

Gel inside the cell membrane.

4.1.4 Ribosome

4.2 Optional external parts of prokaryotic cells

4.2.1 Cell wall

This lies outside the cell membrane. This provides the cell with structural support, and allows material through to the membrane.

4.2.2 Flagellum

This is a "tail" used for movement.

4.2.3 Glycocalyx

This is a layer outside the cell wall for some cells. This can assist with cell-to-cell communication.

4.3 Chemicals in prokaryotic cells

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Neuroscience

7.1 Introduction

7.1.1 Single neuron

Neurons have:

+ Dentrite (takes message from other neurons + Cell body + Axon

Charge across neuron is mediated by ions. Positive or negative.

If the dentrite is stimulated, then charge increases at that point. But large number of inputs to dentrite

If many stimulated, then overall charge can change.

7.1.2 Two neurons

When stimulated, the axon stimulates dentrites of other neurons.

Axons are connected to other neurons via synapses.

When axon is positively charged, it releases neurotransmitters into the synapse.

Receptors in the dentrite detect these and positive charge released in dentrite.

Neurotransmitters removed by reuptake into axon, or break down by enzyme in synapse.

Different types of neurotransmitter can be released by the same axon. Some short lasting, long lasting, inhibitors.

page on different types of neurotransmitters? seretonin, dopamine etc

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SSRI

testosterone

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13.1.1 White blood cells

T cells.

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Susceptible, Infectious, or Recovered models (SIR)

14.1 Introduction

14.1.1 Assumtions

Generally, k states, markov chain?

Assumptions are:

+ Lasting immunity + No births/other deaths

Components:

+ $S(t)$ - Susceptible + $I(t)$ - Infected + $R(t)$ - Removed (recovered or died)

Proportion of people who recover each period - γ.

Each period, infected can transmit to β people. Total of $I\beta$.

Not everyone susceptible though, so $I\beta\frac{S}{N}$

Dynamics:

$$+ \frac{dR}{dt} = \gamma I + \frac{dS}{dt} = -\beta I\frac{S}{N} + \frac{dI}{dt} = \beta I\frac{S}{N} - \gamma I$$

Note that $dfracdRdt + dfracdIdt + \frac{dS}{dt} = 0$

We can then work out $\frac{dI}{dS}$

$$\frac{dI}{dS} = \frac{\frac{dI}{dt}}{\frac{dS}{dt}}$$

$$\frac{dI}{dS} = \frac{\beta I \frac{S}{N} - \gamma I}{-\beta I \frac{S}{N}}$$

$$\frac{dI}{dS} = \frac{\beta S - \gamma N}{-\beta S}$$

$$\frac{dI}{dS} = -1 + \frac{\gamma}{\beta}\frac{N}{S}$$

We can then work out $\frac{dS}{dR}$

$$\frac{dS}{dR} = \frac{\frac{dS}{dt}}{\frac{dR}{dt}}$$

$$\frac{dS}{dR} = \frac{-\beta I \frac{S}{N}}{\gamma I}$$

$$\frac{dS}{dR} = -\frac{\beta}{\gamma}\frac{S}{N}$$

We can rewrite the infection dynamic:

$$+ \frac{dI}{dt} = \beta I \frac{S}{N} - \gamma I + \frac{dI}{dt} = I(\beta \frac{S}{N} - \gamma) + \frac{dI}{dt} = I\gamma(\frac{\beta}{\gamma}\frac{S}{N} - 1)$$

This means that outbreak if $\frac{\beta}{\gamma} > \frac{S}{N}$

$$R_0 = \frac{\beta}{\gamma}$$

What is steady state?

$$\frac{dI}{dt} = I(\beta \frac{S}{N} - \gamma)$$

$$\frac{dI}{dt} = 0$$

$$R_0 \frac{S}{N} = 1)$$

$$\frac{S}{N} = \frac{1}{R_0})$$

$$\frac{\beta}{\gamma} > \frac{S}{N}$$

14.1.2 Vaccinations

What proportion need vaccination?

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Variations on SIR models

15.1 Variations on SIR models

15.1.1 SIR model with births and other deaths

15.1.2 Exposure period (SEIR model)

Susceptible, exposed, infectious, recovered.

15.1.3 No lasting immunity (SIS model)

can do SI_1SI_2.

No lasting immunity

Susceptible - Infected - Susceptible

Infected model as before

15.1.4 SIRS

short period of no infection

15.1.5 SEIS (with exposure)

no long term immunity

15.1.6 Sesonal effects

β varies over time

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MSIR

born with immunity

MSEIR

MSEIS

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19.4.1 Tomato

19.4.2 Onion

19.4.3 Pepper

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19.4.5 Carrot

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20.2.1 Pans

20.2.2 Frying

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20.3.1 Grilling

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20.4.1 Ovens

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20.5.1 Steaming

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21.2.1 Making dough

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21.3.1 Bread

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21.4.1 Pasta

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24.1.1 Coffee

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24.3.1 Wine

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24.4.1 Tea

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25.1.1 Sofrito

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