Exercise sheet 1: Biology Basics

Exercise 1 - General

Here are some general biology questions. Using the Possible Solutions tab will convert each question to multiple choice. In the solution only correct answer sare ticked.

1a)

Where is the genome stored in prokaryotes and eukaryotes?

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Hint : Possible Answers

- ☐ Inside the nucleus in eukaryotes
- ☐ Outside the cell in prokaryotes
- ☐ Prokaryotes have no genome
- ☐ Inside the nucleolus in prokaryotes
- ☐ In chromatin in eukaryotes
- ☐ Partially in mitochondria in prokaryotes
- ☐ Directly inside the cell in prokaryotes

Correct Answer

- ☒ Inside the nucleus in eukaryotes
- ☐ Outside the cell in prokaryotes
- ☐ Prokaryotes have no genome
- ☐ Inside the nucleolus in prokaryotes
- ☐ In chromatin in eukaryotes
- ☐ Partially in mitochondria in prokaryotes
- ☒ Directly inside the cell in prokaryotes

1b)

Name more differences between prokaryotes and eukaryotes?

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Hint : Possible Answers

- ☐ Prokaryotes have compartmentation through membrane
- ☐ Eukaryotes are not multi-cellular organisms
- ☐ Prokaryotes have mitochondria
- ☐ Eukaryotes have no nucleus
- ☐ Prokaryotes have no ER
- ☐ Eukaryotes are single cell organisms
- ☐ Eukaryotes have no flagellum

Correct Answer

- ☐ Prokaryotes have compartmentation through membrane
- ☐ Eukaryotes are not multi-cellular organisms
- ☐ Prokaryotes have mitochondria
- ☐ Eukaryotes have no nucleus
- ☒ Prokaryotes have no ER
- ☐ Eukaryotes are single cell organisms
- ☐ Eukaryotes have no flagellum

1c)

List examples of prokaryotes and eukaryotes.

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Hint : Possible Answers

- ☐ Escherichia coli is a prokaryote
- ☐ Amoebas are prokaryotes
- ☐ Fungi are eukaryotes
- ☐ Archaea are eukaryotes
- ☐ Insects are eukaryotes
- ☐ Salmonella is a prokaryote
- ☐ Plasmodium malariae is a prokaryote

Correct Answer

- ☒ Escherichia coli is a prokaryote
- ☐ Amoebas are prokaryotes
- ☒ Fungi are eukaryotes
- ☐ Archaea are eukaryotes

☒ Insects are eukaryotes
☒ Salmonella is a prokaryote
☐ Plasmodium malariae is a prokaryote

1d)

What are the three information-carrying biopolymers?

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Hint : Possible Answers

☐ Protein
☐ Cellulose
☐ DNA
☐ Polysaccharides
☐ RNA
☐ amino acid
☐ nucleotide

Correct Answer

☒ Protein
☒ DNA
☒ RNA

1e)

What is denoted by the "Central Dogma" of molecular biology?

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Hint : Possible Answers

☐ Protein can make Protein
☐ DNA can make DNA
☐ Protein can make RNA and then RNA makes DNA
☐ DNA can make RNA and then RNA makes Protein
☐ RNA can make RNA
☐ DNA can make RNA and then RNA makes DNA
☐ Protein can make DNA

Correct Answer

- ☐ Protein can make Protein
- ☒ DNA can make DNA
- ☐ Protein can make RNA and then RNA makes DNA
- ☒ DNA can make RNA and then RNA makes Protein
- ☒ RNA can make RNA
- ☒ DNA can make RNA and then RNA makes DNA
- ☐ Protein can make DNA

Exercise 2 - DNA and RNA

The genetic information of an organism is stored in the DNA in the form of a code. This code consists of four building blocks or bases (A for adenine, C for cytosine, G for guanine, T for thymine). These bases or nucleotides follow each other in a certain sequence, e.g.:

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AGTCGTAATTGGCCCCAATTGCAAAAA
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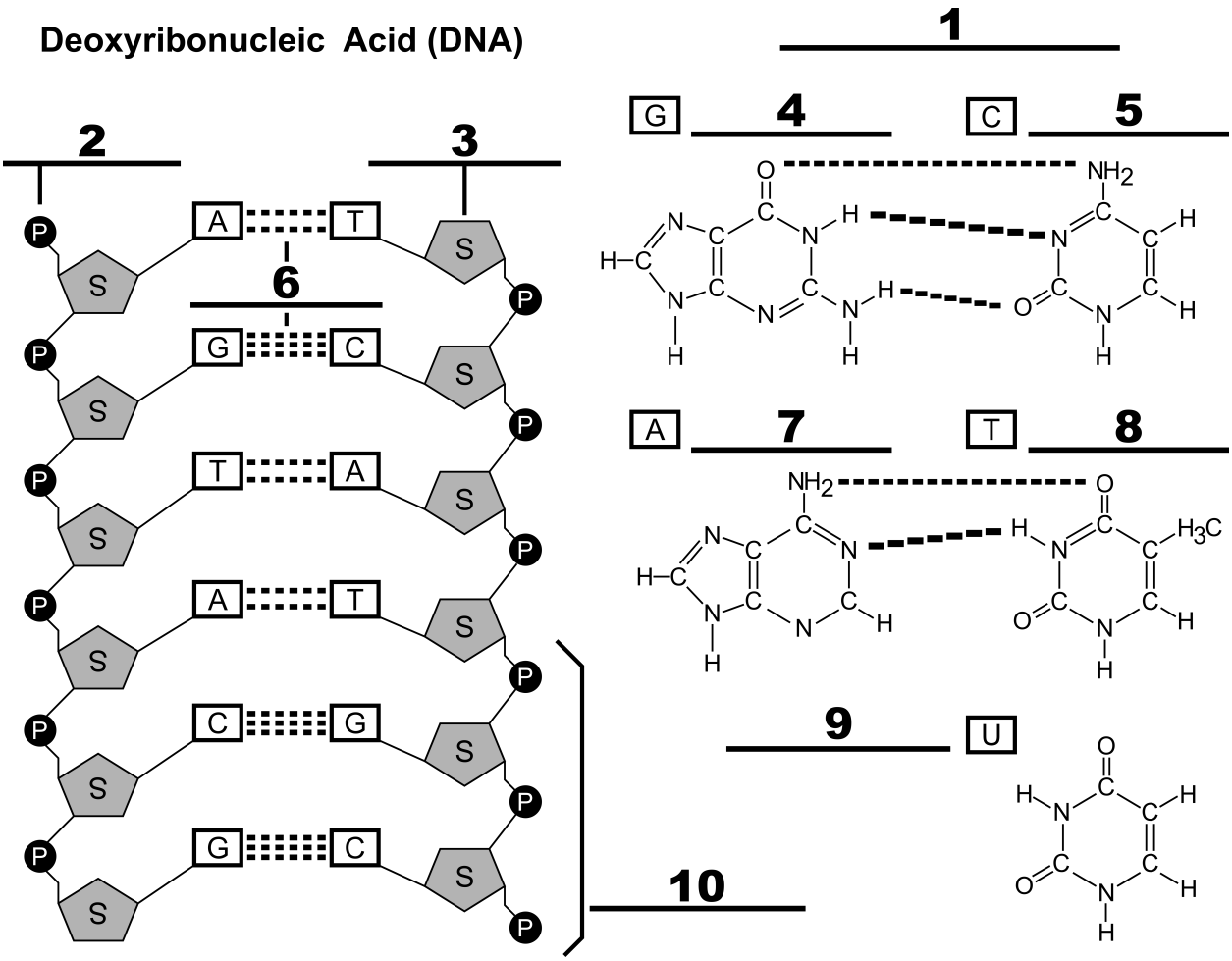
A single hereditary unit consists of a subsequence of DNA (called a gene), which contains the information to build a functional RNA or protein molecule.

2a)

Match these terms to the correct number in the figure below: adenine, thymine, cytosine, guanine, uracil, phosphate, deoxyribose, hydrogen bond, backbone, and bases.



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Hint

1. bases
2.
3. deoxyribose
4.
5.
6. hydrogen_bond
7.
8. thymine
9.
10. backbone

Correct Answer

1. bases

2. phosphate
3. deoxyribose
4. guanine
5. cytosine
6. hydrogen_bond
7. adenine
8. thymine
9. uracil
10. backbone

2b)

A piece of DNA contains 33% guanine. What are the percentages of adenine, cytosine, and thymine in that piece of DNA?

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Hint What is the percentage of cytosine?

What is the combined percentage of guanine and cytosine?

What is the combined percentage of adenine and thymine?

Correct Answer

- guanine: 33%
- cytosine: 33%
- adenine: 17%
- thymine: 17%

2c)

Decide which bases are pyrimidines and which are purines:

- **A** - Adenine
- **C** - Cytosine
- **G** - Guanine
- **T** - Thymine
- **U** - Uracil.

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Correct Answer

- pyrimidines:
  - **C**
  - **T**
  - **U**
- purines:
  - **A**
  - **G**

2d)

Which of these statements concerning DNA and RNA are correct?

Statements

☐ Uracil is a standard base in RNA
☐ DNA is longer than RNA
☐ DNA and RNA have a different structure
☐ RNA has an intermolecular double-helix structure
☐ RNA contains ribose sugar

Correct Answer

☒ Uracil is a standard base in RNA
☒ DNA is longer than RNA
☒ DNA and RNA have a different structure
☐ RNA has an intermolecular double-helix structure
☒ RNA contains ribose sugar

2e)

In what direction is an RNA sequence written?

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Hint

- ☐ 3' end to 5' end
- ☐ 5' end to 3' end

Correct Answer

- ☐ 3' end to 5' end
- ☒ 5' end to 3' end

2f)

Why is the RNA sequence written in that direction?

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Hint: Possible Answers

- ☐ The order is based on the numbering of the carbons in the sugar of the nucleic acid
- ☐ The order is based on the numbering of the carbons in the phosphate of the nucleic acid
- ☐ The order was arbitrarily chosen by the discoverer of RNA

Correct Answer

- ☒ The order is based on the numbering of the carbons in the sugar of the nucleic acid
- ☐ The order is based on the numbering of the carbons in the phosphate of the nucleic acid
- ☐ The order was arbitrarily chosen by the discoverer of RNA

Note

The carbon-atoms in the sugar of the nucleic acid are numbered from 1 to 5. In the phosphate-sugar backbone, C5 and C4 are the carbon atoms that connect to the phosphate group so that 5' denotes the end of the chain where C5 is the closest and 3' denotes the ed where C3 is the closest.

2g)

Decide for the following RNAs whether they are coding or non-coding: mRNA, tRNA, rRNA, microRNA, siRNA, snoRNA

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Hint There is only one coding RNA

Correct Answer

- coding: mRNA
- non-coding: tRNA, rRNA, microRNA, siRNA, snoRNA

Exercise 3 - DNA and RNA

3a)

What do these acronyms stand for within this course?

- DNA
- RNA
- ncRNA
- mRNA
- UTR
- ORF
- CDS

Hide

Hint

☐ non-coding-RNA
☐ Opposite-Reading-Frame
☐ Deoxyribonucleic acid
☐ non-complementary-RNA
☐ missense-RNA
☐ messenger-RNA
☐ ribonucleic acid
☐ untranslated region
☐ coding-strand
☐ coding-sequence
☐ open reading frame

Correct Answer

☒ DNA - Deoxyribonucleic acid
☒ RNA - Deoxyribonucleic acid
☒ ncRNA - non-coding-RNA
☒ mRNA - messenger-RNA
☒ UTR - untranslated region
☒ ORF - open reading frame
☒ CDS - coding-sequence

3b)

Check whether the following terms belong to Eukaryotes, Prokaryotes or both.

Terms DNA

- ☐ Eukaryotes
- ☐ Prokaryotes

splicing

- ☐ Eukaryotes
- ☐ Prokaryotes

transcription

- ☐ Eukaryotes
- ☐ Prokaryotes

ncRNA"

- ☐ Eukaryotes
- ☐ Prokaryotes

single-cell-organism

- ☐ Eukaryotes
- ☐ Prokaryotes

Hint DNA

- ☐ Eukaryotes
- ☐ Prokaryotes

splicing

- V Eukaryotes
- x Prokaryotes

transcription

- V Eukaryotes
- V Prokaryotes

ncRNA"

- ☐ Eukaryotes
- ☐ Prokaryotes

single-cell-organism

- ☐ Eukaryotes
- ☐ Prokaryotes

Correct Answer DNA

- ☒ Eukaryotes
- ☒ Prokaryotes

splicing

- ☒ Eukaryotes
- ☐ Prokaryotes

transcription

- ☒ Eukaryotes
- ☒ Prokaryotes

ncRNA”

- ☒ Eukaryotes
- ☒ Prokaryotes

single-cell-organism

- ☐ Eukaryotes
- ☒ Prokaryotes

3c)

Check whether the following statements are True or False.

Statements

- ☐ The genome is stored in the nucleus
- ☐ FASTA files are used to store sequence information
- ☐ A Watson-Crick base pair describes a pyrimidine pairing with a purine
- ☐ A Watson-Crick base pair describes a purine pairing with a purine
- ☐ RNA is a single stranded bio-polymer

Hint

- ☐ The genome is stored in the nucleus
- V FASTA files are used to store sequence information
- ☐ A Watson-Crick base pair describes a pyrimidine pairing with a purine
- x A Watson-Crick base pair describes a purine pairing with a purine
- ☐ RNA is a single stranded bio-polymer

Correct Answer

- ☐ The genome is stored in the nucleus
- ☒ FASTA files are used to store sequence information
- ☒ A Watson-Crick base pair describes a pyrimidine pairing with a purine
- ☐ A Watson-Crick base pair describes a purine pairing with a purine
- ☐ RNA is a single stranded bio-polymer

Exercise 4 - Programming assignment

Programming assignments are available via Github Classroom and contain automatic tests.

We recommend doing these assignments since they will help you to further understand this topic.

Access the Github Classroom link: Programming Assignment: Sheet 01.
