GENETICS MULTIPLE CHOICE QUESTIONS

Here are a series of multiple choice questions accompanying the animated genetics resources.

Introducing genetics concepts:
http://www.sicklecellanaemia.org/teaching-resources/resources/scooter66-71/scooter66.html

The genetics of alpha globin:
http://www.sicklecellanaemia.org/teaching-resources/resources/scooter10-23/scooter13.html

The genetics of beta globin:
http://www.sicklecellanaemia.org/teaching-resources/resources/scooter10-23/scooter19.html

MCQ Introducing genetics concepts
MCQ Alpha globin genetics
MCQ Beta globin genetics
Answers Introducing genetics concepts
Answers Alpha globin genetics
Answers Beta globin genetics

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MCQ INTRODUCING GENETICS CONCEPTS

1. What is the name of the region of DNA located at the ends of the chromosomes?
   - Telomere
   - Centromere
   - Acromere
   - Chromomere

2. What is the name of the indented region near the centre of the chromosome?
   - Telomere
   - Centromere
   - Acromere
   - Chromomere

3. How many chromosomes are there in a human cell?
   - 46
   - 23
   - 44
   - 22

4. What type of nucleotide can be found in DNA molecule?
   - Uracil
   - Cysteine
   - Adenine
   - Guanosine

5. During which phase of mitotic division is DNA usually extracted for karyotyping?
   - Anaphase
   - Prophase
   - Metaphase
   - Any of the mitotic phases

6. When constructing a karyogram, how are the chromosome pairs arranged?
   - Descending size order with the sex chromosome at the end
   - Descending size order
7. An ideogram is a diagrammatic representation of the karyograme. How are the chromosomes orientated?

- With the short “p” arm pointed upwards
- With the long “q” arm pointed downwards
- Lined up along the centromeres
- All of the above

8. Cytogenic location is a numbering convention used to locate genes on chromosomes. What letter are the short and long chromosome arms designated?

- Short = p, long = q
- Short = q, long = p
- Short = s, long = l
- Short = t, long = d

9. How in cytogenetic mapping would the position of a gene located on the long arm of chromosome four be annotated?

- 4p
- 4q
- 2p
- 2q

10. How in cytogenetic mapping the position of the gene located on the short arm of the second chromosome, region 1, band 2 and sub-band 3, would be describe?

- 2p12.3
- 2q1.23
- 2p1, 2.3
- 12p2.3

11. The CFTR gene regulates the movement of which ion through the ion channel?

- Ca²⁺
- K⁺
- Cl⁻
- Na²⁺
12. Clusters of 3 nucleotides that encode each amino acid are called what?
   - Codon
   - Exon
   - Intron
   - None of the above

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### MCQ ALPHA GLOBIN GENETICS

1. How many individual globin subunits form the human haemoglobin molecule?
   - 1 subunit
   - 2 subunits
   - 3 subunits
   - 4 subunits

2. What metal element is contained within the haemoglobin molecule?
   - Magnesium
   - Sodium
   - Iron
   - Lead

3. Haemoglobin A (HbA) is the most common adult variant form of haemoglobin. Which four globin subunits form HbA?
   - (alpha beta) 2
   - (alpha delta)2
   - (alpha epsilon)2
   - (alpha alpha)2

4. On which chromosome is the Hb ALPHA gene located?
   - Chromosome 16
   - Chromosome 11
   - Chromosome 9
   - Chromosome 3

5. Where the alpha globin gene is precisely located?
   - 11p 15.5
   - 11q 11.5
   - 16p 13.3
   - 16q13.3
6. Gene expression alters with life-stage and in turn causes different Hb molecules to be synthesised at different times. Which Hb molecules are produced in the embryonic phase?

   Gower 1, Gower 2 and Portland 1
   Gower 1 and Gower 2
   Portland 1 and Portland 2
   Foetal (HbF) and Gower 1

7. At what time point do adult forms of haemoglobin finally stabilise?

   Around 6 month after conception
   Around 9 months after birth
   Around 6 month after birth
   Around 3 month after birth

8. Which of the following statements is NOT correct?

   Exons are regions of genetic code that are translated into protein
   Introns are regions of genetic code that are not translated into protein
   Introns are regions of genetic code that are translated into protein
   A nucleotide sequence comprises of introns and exons

9. How many exons does the alpha 1 globin gene have?

   Two
   Four
   Three
   Six

10. Name the first amino acid encoded for the alpha globin molecule by atg codon which is absent in the mature protein?

    Valine
    Lysine
    Arginine
    Methionine

11. How long is the mature alpha globin protein?

    131 amino acids
    141 amino acids
    142 amino acids
    114 amino acids
12. A genetic mutation in the alpha globin gene may cause a haemoglobinopathy or haemoglobin disorder. If at nucleotide number 20, arginine mutates into thymine. How is this annotated?

- 20A>T
- 20T<A
- 20A<T
- 20T>A

**MCQ BETA GLOBIN GENETICS**

1. The beta globin molecule is a component part of which variant of haemoglobin?

- Gower 1
- Foetal Hb
- Adult HbA
- Adult HbA2

2. At what life stage does HbA start to be synthesised?

- Embryonic phase
- Foetal phase
- Infancy (mainly from birth onwards)
- In adult hood

3. What is the chromosomal location of the beta haemoglobin gene?

- 11
- 12
- 16
- xy

4. Where on the designated chromosome is the beta globin gene located?

- Close to the centromere at p15.5
- Close to the telomere at p15.5
- Close to the centromere at p11.12
- Close to the telomere at p11.12

5. The β–globin gene comprises of how many base pairs?

- 1200
- 1400
- 1600
- 1800
6. Which of the following statements is correct with reference to the beta globin gene cluster?

- It comprises of three exons and two untranslated regions (UTR)
- It comprises of two exons and three untranslated regions (UTR)
- It comprises of two exons and two untranslated regions (UTR)
- It comprises of three exons and three untranslated regions (UTR)

7. The coding sequence is the region of the mRNA actually translated into protein. When calculating the length of the coding sequence, which of the following is the correct approach?

- The total length of the gene cluster is used
- The number of base pairs forming the untranslated regions is subtracted
- The number of base pairs forming the introns is subtracted
- The number of base pairs forming both the untranslated regions and introns are subtracted

8. The total globin gene cluster is 626 base pairs long. What is the size of the actual coding sequence of the beta gene?

- 426bp
- 444bp
- 344
- 326

9. Which statement correctly describes the mature beta globin molecule?

- 146 amino acids long and similar to the Alpha Globin
- 146 amino acids long and not similar to Alpha Globin
- 147 amino acids long and similar to the Alpha Globin
- 147 amino acids long and not similar to Alpha Globin

10. In the mature protein the first amino acid in the sequence – methionine – is absent. Which amino acid is the first in the sequence?

- Cytosine
- Leucine
- Arginine
- Valine
11. The adult haemoglobin A molecule is formed from alpha and beta globin in what conformation?

   - Dimer pairs
   - Trimer pairs
   - Tetramer Pairs
   - Monomer Pairs

12. Regarding gene mutations in sickle cell disease, which of the following statements is NOT correct?

   - Mutation in the beta globin gene forms haemoglobin S (HbS)
   - Mutation in the alpha globin gene forms HbS
   - If a child inherits HbS from both parents they will have sickle cell disease
   - If a child only inherits HbS from one parent they will have sickle cell trait
ANSWERS INTRODUCING GENETICS CONCEPTS

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   Telomere

2. What is the name of the indented region near the centre of the chromosome?
   Centromere

3. How many chromosomes are there in a human cell?
   46

4. What type of nucleotide can be found in DNA molecule?
   Adenine

5. During which phase of mitotic division is DNA usually extracted for karyotyping?
   Metaphase

6. When constructing a karyogram, how are the chromosome pairs arranged?
   Descending size order with the sex chromosome at the end

7. An ideogram is a diagrammatic representation of the karyogram. How are the chromosomes orientated?
   All of the above

8. Cytogenic location is a numbering convention used to locate genes on chromosomes. What letter are the short and long chromosome arms designated?
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9. How in cytogenetic mapping would the position of a gene located on the long arm of chromosome four be annotated?
   4q

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    2p12.3

11. The CFTR gene regulates the movement of which ion through the ion channel?
    Cl⁻

12. Clusters of 3 nucleotides that encode each amino acid are called what?
    Codon
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   4 subunits

2. What metal element is contained within the haemoglobin molecule?  
   Iron

3. Haemoglobin A (HbA) is the most common adult variant form of haemoglobin. Which four globin subunits form HbA?  
   (alpha beta) 2

4. On which chromosome is the Hb ALPHA gene located?  
   Chromosome 16

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   Around 9 months after birth

8. Which of the following statements is NOT correct?  
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10. Name the first amino acid encoded for the alpha globin molecule by atg codon which is absent in the mature protein?  
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12. A genetic mutation in the alpha globin gene may cause a haemoglobinopathy or haemoglobin disorder. If at nucleotide number 20, arginine mutates into thymine. How is this annotated?  
    20A>T
1. The beta globin molecule is a component part of which variant of haemoglobin?
   Adult HbA

2. At what life stage does HbA start to be synthesised?
   Infancy (mainly from birth onwards)

3. What is the chromosomal location of the beta haemoglobin gene?
   11

4. Where on the designated chromosome is the beta globin gene located?
   Close to the centromere at p15.5

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10. In the mature protein the first amino acid in the sequence – methionine – is absent. Which amino acid is the first in the sequence?
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11. The adult haemoglobin A molecule is formed from alpha and beta globin in what conformation?
    Dimer pairs

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