**ATAR HUMAN BIOLOGY – UNIT 2**

**Task 11 – Inheritance (DNA) Practical**

**Breeding Reebops Assessment**

NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ WEIGHTING: 5%

TEACHER: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ TOTAL MARK: \_\_\_\_ / 40

PART 1 MARK: \_\_\_ / 11 PART 2 MARK: \_\_\_ / 29

The following practical will lead you through a breeding program of imaginary animals called **Reebops** using the same procedures as in a breeding program with real organisms, and applying the same rules that are found in genetics. To carry out the practical you will need to draw upon your knowledge of DNA, genes and chromosomes, meiosis and the laws of inheritance.

**The assessment will be in two parts.**

**Part 1** – Time 1 class period

You are going to carry out a breeding program for Reebops. During the breeding program you will be required to take notes of the procedures being used, the genotypes and phenotypes of the animals in the breeding program and any other information you think is relevant.

**Part 2** – Time 1 class period

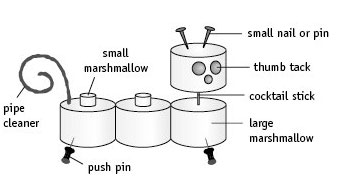
This is a written assignment where you will be required to answer questions using the information you acquired from the breeding program and you general scientific knowledge about genetics.

**Part 1 - Breeding Reebops**

Reebops are imaginary animals made out of marshmallows, lollies and cocktail sticks (to hold together). They have 16 chromosomes (eight pairs) in their somatic cells which determine their characteristics. Below is the information sheet which outlines the genotypes and phenotypes of the Reebops.

**Genotype Decoding Key:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristic** | **Genotype/ phenotype code** | | |
| Antennae (black liquorish) | **AA** = 2 antennae | **Aa** = 2 antennae | **aa** = no antennae |
| Body segments (*marshmallows*) | **BB** = 3 body segments | **Bb** = 3 body segments | **bb** = 2 body segments |
| Tail (*black liquorish*) | **TT** = curly tail | **Tt** = curly tail | **tt** = straight tail |
| Nose (*candy*) | **NN** = Red nose | **Nn** = orange nose | **nn** = yellow nose |
| Legs (*musk sweets + red liquorish*) | **LL** = Pink legs | **Ll** = Pink legs | **ll** = Red legs |
| Sex (*colour of marshmallow*) | **XX** = female (pink) | **XY** = male (white) |  |
| Eyes (*candy*) | **EE** = 2 eyes | **Ee** = 2 eyes | **ee** = one eye |
| Humps (*small marshmallows*) | **HH** = 1 hump | **Hh** = 1 hump | **hh** = 3 humps |



Black liquorish

Candy

This is what a Reebop looks like before it becomes male or female.

Black liquorish

**Part 1** (on lined paper) ***(11 marks)***

Musk sweets/liquorish)

1. You are given a model of an adult male and adult female Reebop. Both parents are **heterozygous** for all their characteristics (except their sex). Study their characteristics.

**Using the information in the chart above record their genotypes and phenotypes for all characteristics. Include any additional notes if needed.**

1. You are provided with two envelopes. One contains Reebop Mum chromosomes and the other contains Reebop Dad chromosomes. There are 16 chromosomes (eight pairs) in each envelope. Open the envelope and take out the pack of cards.

**\*You are now going to carry out a breeding program to create a baby Reebop\***

1. Turn the chromosome cards face down, so that you cannot see the genotypes (letters) on them. Keep the Mum and Dad chromosomes separate, so that you have two groups of cards.
2. Sort the Mum cards into pairs of the same length. Repeat for Dad’s.
3. Now randomly take one chromosome of each paired length from the Mum chromosomes and place them in a pile. Repeat for each pair of Dad chromosome and place them in a different pile.
4. Now carry out “fertilisation” by mixing the female and the male piles to form a “baby gene pile”.
5. Put the remaining chromosomes back into the envelopes.
6. **Record the genotype and phenotypes of the Reebop baby you have created.** Refer to the genotype decoding key to check the characteristics your baby has inherited.
7. Using the materials supplied, create your baby Reebop. Your baby will be assessed.
8. Now you have created your baby add it to the nursery provided. Have a look at the other babies present. Remember that all the Mum Reebops had the same chromosomes as one another and that each Dad Reebop had the same chromosomes as the other Dads.
9. **What do you notice about the features that the babies have?**
10. **Are there any babies that are identical?**
11. **How many babies are the same as their parents? Which parent?**
12. The babies grow up rapidly and become parents for the next generation of Reebops. Choose a baby to breed with your baby. **Record the genotype and phenotype of the other Reebop.**
13. Choose **one** feature. Draw a punnet square to show the possible baby Reebops your couple could have using the feature you choose, include the parents genotypes and the possible outcomes.

Part 1 – mark allocation

1. *Genotypes and phenotypes of parents recorded accurately. (1 mark)*
2. *Genotypes and phenotypes of baby recorded accurately. (2 marks)*
3. *Baby created according to phenotype. (1 marks)*
4. *Notes made on babies and their characteristics in the nursery. (3 marks)*
5. *Genotype and phenotype of “mate” recorded. (1 mark)*
6. *Punnet square of cross drawn accurately for chosen characteristic and outcomes. (3 marks)*

**Task 11 – Inheritance Practical, Part 2 *(29 marks)***

Using the data you collected from Part 1 of this assessment, complete the following questions. Be sure to read each question carefully before writing your answer.

**Question 1**

1. State two similarities and one difference between the inheritance of the nose characteristics and the inheritance of the leg characteristics; include the name of each type of pattern of inheritance. *(5 marks)*

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2019: add more lines. Everyone needed more.

1. The symbols shown on the Decoding Key for the nose genotype are incorrect. Describe how you could change the symbols used to properly represent this type of inheritance.  *(1 mark)*

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**Question 2**

1. You initially created two piles of ‘chromosomes’ in the breeding program, one for Mum and one for Dad. State what biological structure these represented. *(1 mark)*

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1. Name and describe two processes that can occur during the formation of the gametes that can cause variation. *(3 marks)*

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**Question 3**

List the genotypes and phenotypes of your Reebop.  *(1 mark)*

**Question 4**

Answer the following using the information you collected from the baby Reebops in the nursery.

1. What was the most common phenotype for the characteristic you chose, amongst the babies? *(1 mark)*

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1. Is this the expected trend that you would predict for this characteristic? Explain your answer. *(2 marks)*

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**Question 5**

1. During your breeding program, your Reebop grew up and had offspring of its own. In the space below, draw a pedigree chart for the trait you chose including the two filial generations that you observed during your breeding program. Your Reebop and its partner had two children, decide on their phenotype. *(2 marks)*
2. Is it possible to determine the genotype of the two offspring in the second filial generation using your pedigree chart? Explain your answer.  *(2 marks)*

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**Question 6**

How many males and females were present in the nursery? \_\_\_\_\_\_\_ males, \_\_\_\_\_\_\_ females.

1. When a couple have a baby the expected ratio of males to females is 1:1. Justify the ratio of males to females obtained in your breeding program. *(2 marks)*

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1. If you wanted to carry out a breeding program, which ensured all the offspring had 2 antennae, you would only breed pure-breed adults.

Explain why only pure breeding adults would be used. *(2 marks)*

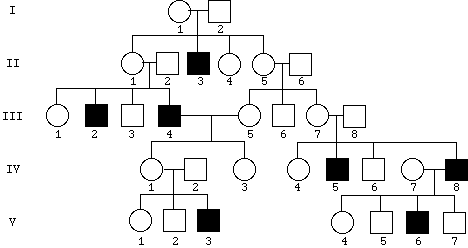
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How could a breeder prove for certain that his 2-antennae adult was a pure bred? *(2 marks)*

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**Question 7**

The pedigree chart below shows the inheritance of the condition “Stacky Back” in Reebops, where a body segment is smaller than normal leading to stability issues.



a) What is the most likely pattern of inheritance shown in the pedigree chart? *(1 mark)*

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b) Explain your answer, with reference to the pedigree chart. *(2 marks)*

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c) What is the genotype of *IV child 3? (1 mark)*

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(ii) If this female gets together with a healthy male Reebop, what is the probability that she will have a male baby with the condition “Stacky Back”? Include a punnet square in your answer. *(2 marks)*

**Question 8**

Justify why males are more commonly affected by recessive sex-linked disorders than females. *(3 marks)*

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Mark Allocated **Part 1**.

* Genotypes and phenotypes of parents recorded accurately. (1 mark)
* Genotypes and phenotypes of baby recorded accurately. (2 marks)
* Baby created according to phenotype. (1 marks)
* Notes made on babies and their characteristics in the nursery. (3 marks)
* Genotype and phenotype of “mate” recorded. (1 mark)
* Punnet square of cross drawn accurately for chosen characteristic and outcomes. (3 marks)

**Question 1**

State two similarities and one difference between the inheritance of the nose characteristics and the inheritance of the leg characteristics; include the name of each type of pattern of inheritance. *(5 marks)*

*1 – Nose is incomplete dominance*

*1 – Leg is complete dominance*

*1 – Difference: number of phenotypes.*

*2 – Similarities: Neither are sex-linked characteristics. Both are examples of monogenic inheritance. Both types of inheritance rely on only one pair of alleles controlling the inheritance. 3 possible genotypes for each.*

2019: add more lines. Everyone needed more.

The symbols shown on the Decoding Key for the nose genotype are incorrect. Describe how you could change the symbols used to properly represent this type of inheritance.  *(1 mark)*

*Have used capital and small case letters, for codominance must use two capital letters that are different*

*eg RR=red, RW=green, WW=white or NRNR= red, NRNW=green, NWNW= white.*

**Question 2**

You initially created two piles of ‘chromosomes’ in the breeding program, one for Mum and one for Dad. State what biological structure these represented. *(1 mark)*

*Gametes/sperm+egg*

Name and describe two processes that can occur during the formation of the gametes that can cause variation. *(3 marks)*

*1 – Naming any two of: random assortment, mutations, non-disjunction, and crossing over.*

*1 – per description of the source of variation.*

**Question 3**

List the genotypes and phenotypes of your Reebop. *(1 mark)*

*Genotype correct and phenotype correct (1). If mistake no mark in that section*

**Question 4**

What was the most common phenotype for the characteristic you chose, amongst the babies?

Eg.*2 eyes/1eye whichever* *(1 mark)*

Is this the expected trend that you would predict for this characteristic? Explain your answer. *(2 marks)*

*1 mark - Yes or no 1 mark - justification.*

*Eg 2 eye dominant feature, expected ratio of dominant feature when two heterozygous)1) individuals breed is 3:1 (1)*

*If 1 eye the most common need to say not what expected (1) but small group measure ratio may not show(1).*

*2019: perhaps specifically ask about phenotypic ratio. Trend doesn’t tell the students that they need to look at phenotypic ratio.*

**Question 5**

During your breeding program, your Reebop grew up and had offspring of its own. In the space below, draw a pedigree chart for the trait you chose including the two filial generations that you observed during your breeding program. Your Reebop and its partner had two children, decide on their phenotype. *(2 marks)*

*Change wording for 2019: some students only drew 2 generations, but 3 not specified. Perhaps: incl*

*1 mark – pedigree follows proper rules*

*1 mark - babies in second/third generation possible from parents.*

1. Is it possible to determine the genotype of the two offspring in the second filial generation using your pedigree chart? Explain your answer.  *(2 marks)*

*Depends on parents and feature shown by babies. If babies exhibit recessive characteristic (1) then their genotype is easily defined as must be homozygous recessive (1)*

*or*

*If the babies have the dominant characteristic – cannot tell until actually breed (1) unless both parents are homozygous.(1)*

Change to “explain how you could determine’..?

**Question 6**

How many males and females were present in the nursery? \_\_\_\_\_\_\_ males, \_\_\_\_\_\_\_ females.

1. When a couple have a baby the expected ratio of males to females is 1:1. Justify the ratio of males to females obtained in your breeding program. *(2 marks)*

*If it is 50:50 then they can say why using a punnet square or explaining the inheritance of gender using XX and XY.(1) Half sperm x and half sperm Y(1)*

*or*

*If not 50:50 then can explain the difference by saying only small number of offspring (1), so therefore the expected ratio may not become apparent as law of probability does not work unless large number of offspring.(1)*

1. If you wanted to carry out a breeding program, which ensured all the offspring had 2 antennae, you would only breed pure-breed adults.

Explain why only pure breeding adults would be used. *(2 marks)*

*Pure breeding means that they are homozygous for their genotype (1), so can only donate one type of allele/allele donated can be predicted(1)*

How could a breeder prove for certain that his 2-antennae adult was a pure bred? *(2 marks)*

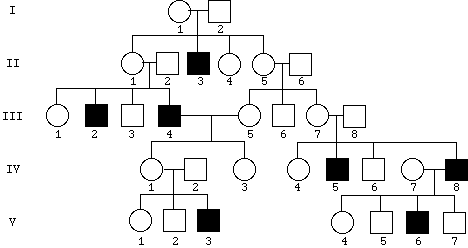
*He could cross his “pure” breed with a recessive 1 antennae (both alleles recessive or has to be homozygous) (1).*

*If all the offspring came out with 2 antennae then could predict a pure breed (would need a lot of offspring to actually prove as a small amount of offspring may not get expected ratio, if some came out showing 1 antennae then know it is not a pure bred (1).*

*Must have that with only a small number of offspring you cannot be 100% certain a pure bred, it just Implies.*

**Question 7**

The pedigree chart below shows the inheritance of the condition “Stacky Back” in Reebops, where a body segment is smaller than normal leading to stability issues.



a) What is the most likely pattern of inheritance shown in the pedigree chart? *(1 mark)*

*Sex-linked or X-linked*

b) Explain your answer, with reference to the pedigree chart. *(2 marks)*

*Virtually all people with the condition are male (only one mark), if say recessive as child has characteristic but parents don’t (max 1 mark)*

*To get two marks must have higher order thinking*

*The only female with condition (V 4) has a father with the condition and Mum must be a carrier (2)-not the case in our pedigree? Need to change for next year. I gave only 1 mark if they didn’t refer to a specific individual..*

*Or people without the condition showing only have sons with the condition, to get a daughter need father to have it (2)*

c) What is the genotype of *IV child 3? (1 mark)*

*XBXb (carrier)*

(ii) If this female gets together with a healthy male Reebop, what is the probability that she will have a male baby with the condition “Stacky Back”? Include a punnet square in your answer. *(2 marks)*

***XB Xb*** *(*1 mark for the punnet square correct, 1 mark probability)

**XB** XB XB XB Xb **Probability 50% chance**

**Y** XBY XbY

**Question 8**

Justify why males are more commonly affected by recessive sex-linked disorders than females. *(3 marks)*

* *They only have one X chromosome (1)*
* *So to inherit a X-linked disease they only have to inherit it from one parent (Mum), there is no matching allele on the other chromosome, so will occur more frequently (1)*
* *For a female to inherit the condition she has to inherit it from both parents as she has two X chromosomes and as disease recessive she must have two alleles for trait to show. (1)*