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1

90948



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Level 1 Science, 2018

90948 Demonstrate understanding of biological ideas relating to genetic variation

9.30 a.m. Thursday 15 November 2018
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of biological ideas relating to genetic variation.	Demonstrate in-depth understanding of biological ideas relating to genetic variation.	Demonstrate comprehensive understanding of biological ideas relating to genetic variation.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Excellence

TOTAL

20

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QUESTION ONE

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Single comb on a chicken

<https://pixabay.com/en/hahn-cockscomb-comb-teeth-farm-66341/>

Rose comb on a chicken

www.flickr.com/photos/archer10/7815488864

The allele for rose comb (R) is **dominant** to the allele for single comb (r) in chickens.

(a) Two rose comb chickens produce a single comb offspring.

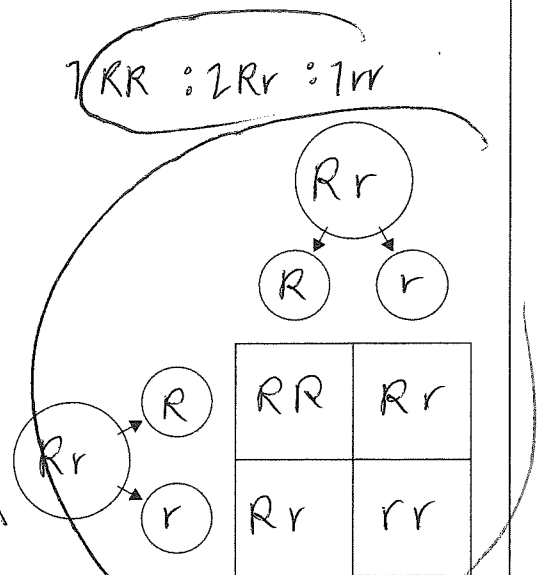
Explain how it is possible for two rose comb chickens to produce a single comb offspring.

In your answer you should:

- define dominant allele
- explain the genotypes of the parents and offspring
- use a Punnett square to help your explanation.

In this situation the dominant allele is for rose comb (R) and the recessive allele is for single comb (r). If the dominant allele is present it is always expressed and it masks the recessive allele.

In order for 2 rose comb chickens to produce a single comb offspring, the parents would have to ~~have~~ both have the heterozygous genotype of Rr so that they both carry 1 recessive allele that could be inherited by the offspring. The single comb offspring would have the homozygous recessive genotype rr having received 1 recessive ~~gene~~ allele from each parent. There is a 3:1 ratio of the dominant allele trait being expressed in a genotype over the recessive allele trait. see Punnett square.

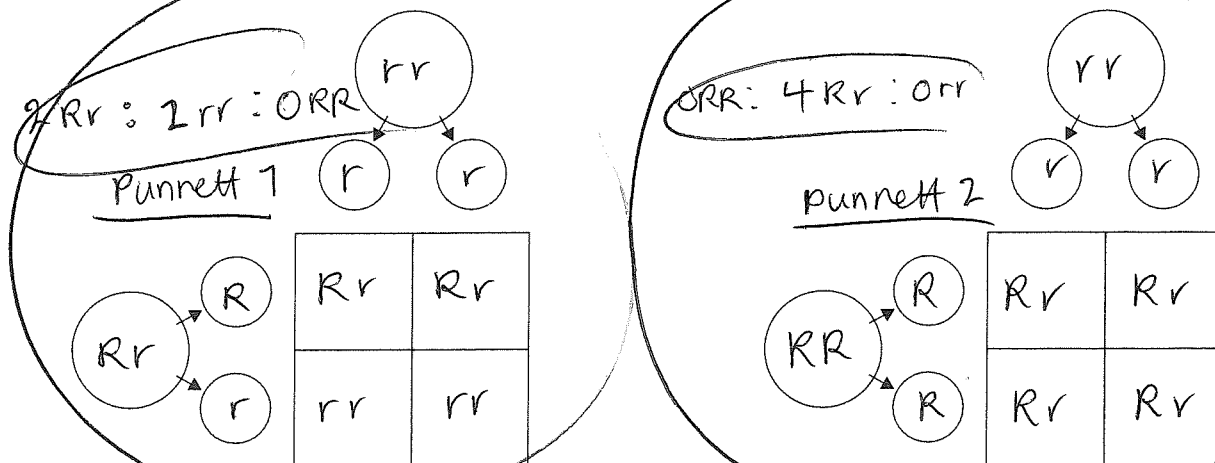


- (b) Explain how a breeder could use crosses to find out if a rose comb chicken has a pure breeding genotype for the trait.

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In your answer:

- define pure breeding and genotype
- use Punnett squares to help you explain
- explain when the breeder could be confident of the chicken's genotype.



When an individual does a test cross it crosses 1 unknown organism with the dominant trait with an organism with the recessive trait in order to find out whether the organism with the unknown genotype is heterozygous or homozygous dominant. When pure breeding is performed organisms are bred with other organisms ^{so that} the offspring expresses the desirable characteristic. ~~not the offspring~~

The breeder could use test crossing to find out if a rose comb chicken has a pure breeding genotype for the trait by crossing it with a single comb chicken which is homozygous recessive. If after many crosses, an offspring with the recessive single comb trait, the breeder can be confident the chicken with the unknown genotype is heterozygous, as it had to have had the recessive allele present to pass on to it's offspring as the recessive trait is only expressed when 2 recessive alleles are present. *Please turn to back.

EJ

QUESTION TWO

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Italian ryegrass in a cornfield

<http://agfaxweedsolutions.com/2017/02/03/mississippi-corn-control-italian-ryegrass-planting/>

Herbicides are chemicals that are used to kill weeds. Over many years, Italian ryegrass (a common weed) has developed a resistance to some herbicides (it is no longer killed by them).

- (a) Explain how **variation** in the Italian ryegrass **population** can help the population develop herbicide resistance.

Variation in the Italian Ryegrass population can help the population develop herbicide resistance through the survival of the fittest idea. Species within the Italian Ryegrass population that can resist herbicides will survive when herbicides are applied and the ones without resistance will die, the species left will be the ones with resistance meaning these are the only Italian Ryegrass species in the population left for breeding, once other varied species breed with this one, the population will begin to consist of only species that can resist herbicides. If variation was not present in the Italian Ryegrass population and the whole species was not immune to herbicides, the whole population would be exterminated all at once.

- (b) Explain how sexual reproduction increases variation in the Italian ryegrass population.

Your answer should include **gamete formation** and **fertilisation**.

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Through Sexual reproduction, variation is increased in the Italian Ryegrass Population because meiosis occurs during sexual reproduction. It occurs in the gametes or sex cells; egg and sperm, where Independent assortment occurs, ~~and~~ where homologous pairs of alleles line up in a random order increasing variation through different combinations of alleles. Crossing over is another operation in Meiosis which allows for variation in which chromosomes swap genetic material or DNA. When an egg is fertilised this also increases variation within the species because fertilisation is a random process in which previous events do not affect future events. ~~Each gamete also carries half a set of chromosomes, so when the Italian Ryegrass is fertilised the offspring gains half of it's chromosomes from the father plant ^{through sperm} and half from the mother plant through the egg/orum; this increases variation further as the mother and father plants could be from different species and they also have ~~different~~ ^{unique} chromosomes. A mutation can also lead to variation in an offspring and this also occurs during fertilisation in which it is a permanent change in the base sequence of DNA that can be passed onto future offspring.~~

M6

QUESTION THREE

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A coloured tūi

<https://www.flickr.com/photos/sidm/6557924841>

A white tūi

<http://mandyart.blogspot.co.nz/2009/07/white-tui-albino-slug.html>

Leucism is a genetic condition caused by a gene mutation that results in some (or all) of an animal being white.

- (a) How could a change in a **gene** result in the **phenotype** of the white tūi shown above?

Your answer should include the terms **DNA** and **allele**.

Punnett squares are not required.

A genetic mutation is caused in the base sequence of DNA ~~which occurs~~ during fertilisation. DNA is a molecule that carries the genetic code for an organism. The mutation or the change in a gene can result in the phenotype of the white tui because when the gene is changed the allele the offspring receives could be the allele for leucism therefore affecting the phenotype and the phenotype could then be the phenotype that is for leucism. The mutation can cause a change in the phenotype because a mutation is a change in the base sequence of DNA meaning that leucism is a mutation as it affects the alleles and then changes the phenotype + all occurring in the base sequence of DNA.

- (b) Explain whether the white colouration would be inheritable or not.

Your answer should include the terms **inheritable** and **non-inheritable**.

The white colouration would be inheritable because ~~leucism~~ ~~leucism~~ is not an environmental factor and can be passed onto the offspring through the passing on of alleles from parent to offspring, and leucism is a genetic condition caused by a gene mutation ~~error~~ occurring in the base sequence of DNA creating a permanent change in the base sequence. If leucism was an environmental factor caused by the tui's environment this would be non-inheritable meaning it will not be able to be passed onto the offspring as environmental factors do not alter the base sequence of DNA like a mutation does.

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M6

Extra paper if required.

Write the question number(s) if applicable.

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NUMBER

Q7

See punnett 1 for diagram relating to my explanation. If however, after many crosses there are no offspring produced with the recessive trait, then it is fair to consider that the rose comb chicken is homozygous dominant and ideal for pure breeding, as no recessive alleles will be passed down by this individual due to its RR genotype (punnett 2). If the breeder wants to be confident that the individual is homozygous dominant and ideal for pure breeding, it can complete a test cross with one of the offspring, again if any recessive single comb chickens are produced, the individual is not ideal for pure breeding rose comb chickens.

See

90948

Subject	Science	Standard	90948	Total score	20
Q	Grade score	Annotation			
1	E8	<p>In (a) there is a very strong description of how the masked/hidden allele is used to describe how chickens with dominant phenotype can produce recessive offspring.</p> <p>In (b) the candidate is strong in describing how the pure breeding trait can be proven by the crossing with rr and then describing ANY = recessive produced, MANY = a way to increase the likelihood and LIKELY with a statement that you can never be totally sure it is RR because Rr can produce rr over many crossed (50% dominant for every cross).</p>			
2	M6	<p>In (a) the candidate does not link the survival to DNA being passed on (A).</p> <p>In (b) the candidate explains both fertilisation and the recombination of alleles/genes/DNA during gamete formation (M and M).</p> <p>It is not an E7 because there is no link to the DNA being passed on.</p>			
3	M6	<p>In (a) the candidate made the links with the change in the gene causing change in the allele and a new phenotype (white). There is no mention of how coloured feathers are produced.</p> <p>In (b) there is no mention of the change in the gene sequencing having to occur in the gametes to be inheritable. Also, there is no mention of coloured feathers. Missing both points means an M6. If one of these two points were given, then the candidate would gain an E7.</p>			