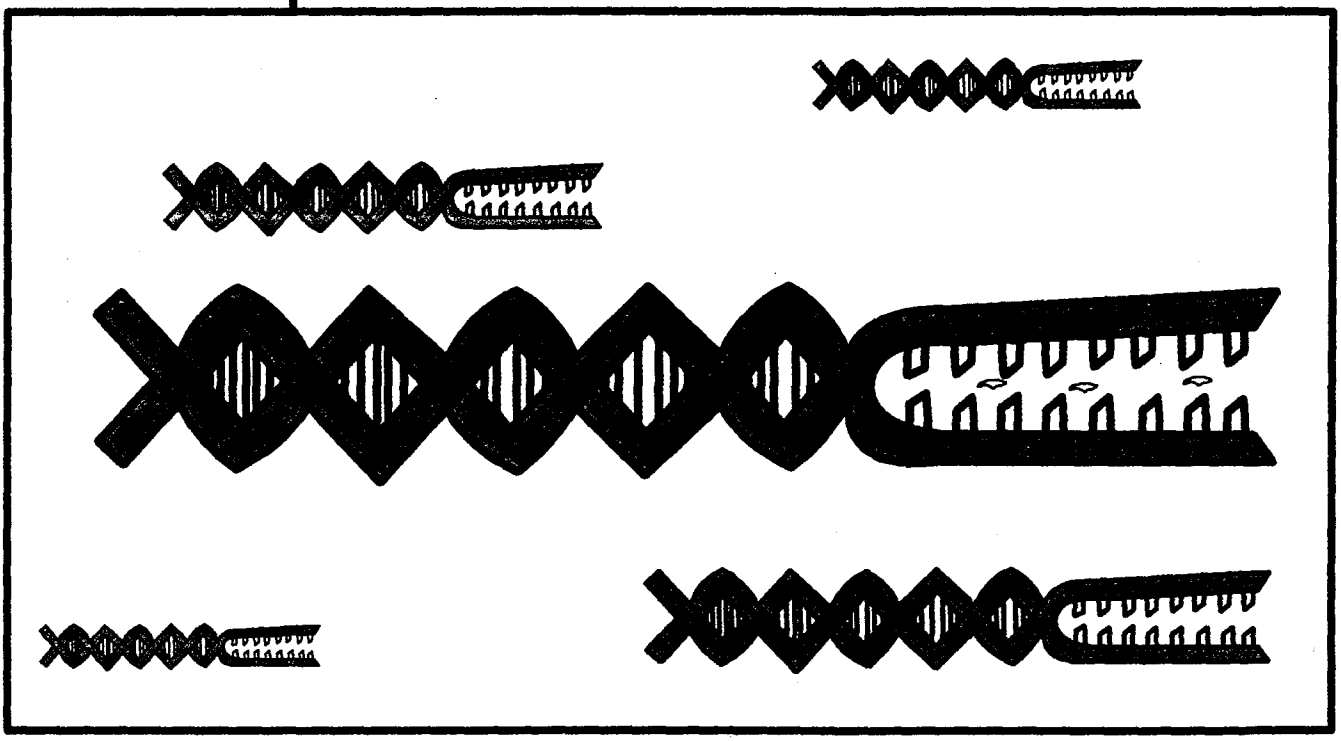
Unit 2

Genetic Continuity



Genetic Facts and Fallacies

Purpose

To determine the extent to which some basic genetic principles and concepts are understood.

Have you ever heard anyone say that the male is the stronger of the two sexes and that he controls the heredity of the child? Or have you heard anyone suggest that an expectant mother attend concerts if she wants her unborn child to become a musician? Through our knowledge of genetics, we have learned that the mother does not influence her unborn child, nor does the father alone control its heredity. In this survey you will determine the extent to which members of your family and your friends believe various statements concerning inheritance.

Part 1 CONDUCTING THE SURVEY AND TABULATING THE RESULTS. The following statements relate to various genetic principles, many of which are associated with common false ideas and superstitions. Certain of the statements are true. Others are false. The purpose of the survey is not to test you, but to provide a survey for you to use.

	True	*False*	*Total*
1. Certain acquired characteristics, such as mechanical or mathematical skill, may be inherited.			
2. Identical twins are always of the same sex.			
3. Fraternal twins are more closely related to each other than to other children in a family.			
4. The father determines the sex of a child.			
5. Each parent contributes half of a child's genetic makeup.			
6. Certain thoughts or experiences of a mother may mark or alter the hereditary makeup of an unborn child.			
7. Color blindness is more common in males than in females.			
8. A person may transmit characteristics to offspring which he, himself, does not show.			
9. Certain hereditary characteristics are influenced by the blood.			
10. Identical twins are more closely related than fraternal twins.			
11. Certain inherited traits may be altered by the stars, moon, or planets early in development.			
12. Males are biologically stronger than females.			
13. The tendency to produce twins may run in families.			
14. A craving for a food such as strawberries may cause a birthmark on an unborn child.			
15. Many of a person's inherited traits are not apparent.			
16. The parent with the stronger will contributes more to a child's inheritance than the other parent.			
17. If a person loses a limb in an accident, it is likely that he or she will have a child with a missing limb.			
18. The attitude of parents toward each other influences the emotional makeup of an unborn child.			
19. Children born to older parents usually lack the vitality of those born to younger parents.			
20. The total number of male births exceeds female births each year.			

Your Personal Genetic Profile

Use table 1 pg 133 to complete your personal profile

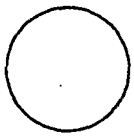
Note: If you have a dominant trait you may not know your full genotype unless one of your parents shows the recessive trait (ie. If you have brown eyes E __ , and one parent is blue eyed ee, then you know that you're Ee. Otherwise leave your genotype as E __)

Trait (use the letter indicated)	Appearance (phenotype)	Dominent or recessive?	Possible genetic makeup (genotype)
Eye colour E/e			
Hairline L/l			
Earlobe T/t			
Ear rim R/r			
Freckles F/f			
Thumb joint J/j			
Finger hair P/p			
Tongue rolling Y/y			
Folded hands D/d			
Nose line N/n			
Hair colour H/h			
Chin dimple G/g			
Clenched fist K/k			

CELL DIVISION

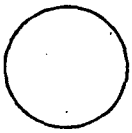
MITOSIS

Original chromosome set:
4 chromosomes
(2 homologous pairs)

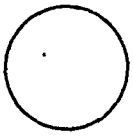


Chromosomes replicate

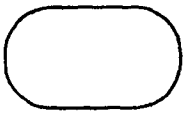
Prophase:
Chromosomes condense, and spindle fibers begin to form.



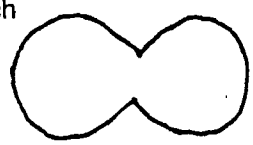
Metaphase:
Chromsomes align along spindle equator.



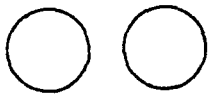
Anaphase:
Sister chromatids separate and move to opposite poles.



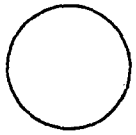
Telophase:
Chromatids end up at each pole and cell divides.



Cytokinesis:
Cell divides forming 2 daughter cells each with chromosomes identical to those in the original nucleus.

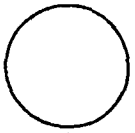


MEIOSIS

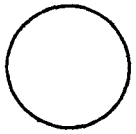


Original chromosome set:
4 chromosomes
(2 homologous pairs)

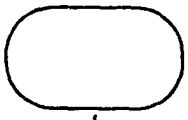
Chromosomes replicate



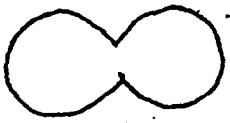
Prophase I:
Replicated chromosomes condense and pair. Spindle fibers begin to form



Metaphase I:
Microtubular spindle aparatus forms and homologous pairs align along the equator.



Anaphase I:
Homologous pairs of chromsomes separate and move to opposite poles.

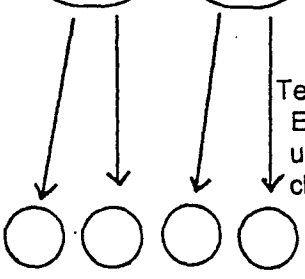


Telophase I:
One set of chromosomes goes to each pole and cell divides.

Prophase II:
Spindle fibers rearrange and recondensation occurs.

Metaphase II:
Chromsomes align along spindle equator.

Anaphase II:
Sister chromatids separate and move to opposite poles.



Telophase II:
Each daughter nucleus ends up with one set of chromosomes (23)

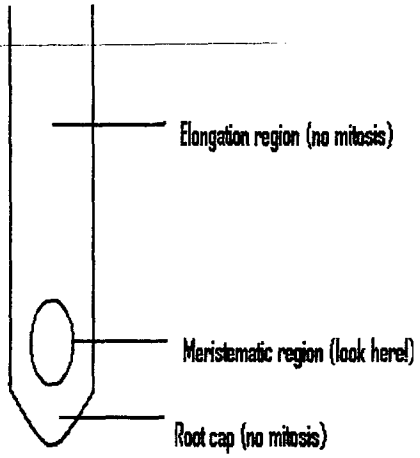
SBI 3UO/E NAME: _____

LAB: FREQUENCY OF CELL DIVISION

PURPOSE: Can we see cells in stages mitosis and determine the frequency of cell division using prepare slides?

MATERIALS: Prepared onion root tip slides, microscopes

PROCEDURE:



1. Obtain an onion root tip slide and place it on the stage of your microscope. View the slide under low-power magnification. Focus using the coarse-adjustment knob.
2. Find the **meristematic region** of the root tip where cells are actively dividing. When you see cells that are dividing (chromosomes visible), move up to medium and then high-power magnification to see the exact stage(s) of division the cells are in.
3. Locate and observe cells in each of the phases of mitosis using **figure 4 pg 88 & 89 as a guide**. It will be necessary to move the slide to find each of the four phases. *Draw, label, and title each of the phases of mitosis.* It is important to draw only the structures that you can actually see under the microscope.
4. Count 20 adjacent onion root tip cells and record whether the cells are in interphase or mitosis.
5. Under high-power magnification, locate 50 onion root cells that are dividing. Do not include cells that are between divisions. Record the number of cells in each phase

OBSERVATIONS: Diagrams of mitotic phases and cell counts.

Title: _____	Title: _____	Title: _____
Title: _____	Cell Counts (20 cells) Interphase _____ Mitosis _____	Cell Counts (50 cells) Prophase _____ Metaphase _____ Anaphase _____ Telophase _____

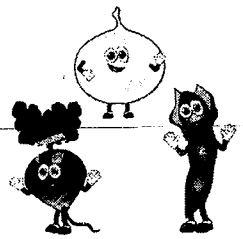
ANALYSIS:

1. Why were plant root tip cells used for viewing cell division?

2. Explain why the cells that you viewed under the microscope do not continue to divide.

3. Calculate the percentage of cells that are dividing using the formula:

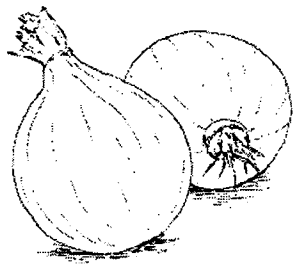
$$\frac{\#\ \text{of cells dividing}}{\text{Total \# of cells counted}} \times 100\% = \_\_\_\_\_\%\ \text{dividing}$$



Show work here:

4. Create a circle graph below showing the percentage of cells in mitosis and the percentage of cells in interphase. Label the diagram appropriately.
5. Calculate the percentage of cells that are in each of the phases of mitosis using a modified formula from question 3.

Show work here:



6. Construct a circle graph below showing the percentages of cells in each phase of mitosis. Include labels and titles.
7. If it takes 12 h for onions to complete one cycle of mitosis, determine the time spent in each phase. Include this information in your circle graph.
8. The number of animal cells in each phase of mitosis was recorded in the table below. If the time taken to complete one cycle of mitosis was 15 h, create a cell division clock below to represent the data.

Mitotic Phase	# of cells in phase
Prophase	15
Metaphase	20
Anaphase	10
Telophase	5

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Name: _____
Teacher:
Date:
Course: SBI3U:Biology, Grade 11, University

Activity 3.3.1

Observing and Determining Frequency of Cell Division

Criteria	Level 1 (50% - 59%)	Level 2 (60% - 69%)	Level 3 (70% - 79%)	Level 4 (80% - 100%)	
Inquiry					
draw the stages of mitosis in onion root-tip cells	the chromosomes are incomplete or hard to see, the lines representing the chromosomes are indistinct, the drawing is not appropriately sized or positioned, the chromosomes shown do not represent the indicated phase	the chromosomes are visible, the lines representing the chromosomes are somewhat indistinct, the drawing is somewhat undersized and mispositioned, some of the chromosomes shown do not represent the indicated phases	the chromosomes are mostly clear and easy to see, the lines representing the chromosomes are fairly distinct, the drawing is appropriately sized and positioned, the chromosomes shown do represent the indicated phases	the chromosomes are all clear and easy to see, the lines representing the chromosomes are sharp and distinct, the drawing is appropriately sized and positioned, the chromosomes do represent the indicated phases	/5
use the correct format for completing a formal lab drawing	the correct drawing materials are not used, the drawing information is missing, there are no labels	the correct drawing materials are used, the drawing information is not complete, the labels are not all on the right of the drawing	the correct drawing materials are used, the drawing information is almost complete, the labels are on the right of the drawing	the correct drawing materials are used, the drawing information is complete including title, magnification, artist's name and date drawn, the labels are on the right of the drawing and in an even column	/5
determine the frequency of cell division in animal and plant cells	the number of cells in mitosis is not recorded, the frequency of mitotic cells is not calculated	the number of cells in mitosis are recorded, the frequency of mitotic cells is stated	the number of cells in interphase and the number in mitosis are recorded, the frequency of mitotic cells is calculated and stated with most steps documented	the number of cells in interphase and the number in mitosis are recorded, the frequency of mitotic cells is calculated and stated with all steps documented	/5
create circle graphs of mitotic frequency	the graph is messy and poorly organized, the frequencies do not correspond with the fractions of the circle	the graph is somewhat messy or somewhat unorganized, the frequencies are close to the correct fractions of the circle	the graph is neat and organized, the frequencies and the fractions of the circle correspond	the graph is very neat and completely organized, the frequencies and the fractions of the circle correspond and are clearly labelled	/5

USE GOOGLE TO FIND "KARYOTYPING ACTIVITY"

Web Karyotyping

Name: _____

Teacher: _____

Patient A

1. _____ (notation)

2. _____ (diagnosis)

Patient B

1. _____ (notation)

2. _____ (diagnosis)

Patient C

1. _____ (notation)

2. _____ (diagnosis)

Internet Research

URL of site: `http://` _____

Title of site: _____

Short description of site: _____

_____

_____

_____

_____

FINDING GENOTYPES AND PHENOTYPES FOR ONE TRAIT

SBI3A0.genetics

PURPOSE: To determine the number of expected genotypes and phenotypes for a genetic cross and compare them with the numbers of observed phenotypes obtained through coin tossing.

MATERIALS: 2 pennies, adhesive tape, pencil, scissors

PROCEDURE:

1. How many of each genotype combination are expected in the offspring of a cross if both parents are Rr for a trait? Use a punnett square and record in column A of Table 1.
2. How many of each genotype combination are expected if there are 100 offspring? Record this number in column B of Table 1.
3. Cover both sides of two pennies with adhesive tape. Print an R on one side of each coin and an r on the other side of each coin.
4. Shake and then toss the coins onto your desk. Read and record the letter combination in column C toss results.
5. Toss the coins a total of 100 times. Record the coin combinations for each toss in Table 1.

Table 1. Expected and Observed Genotypes

Gene combination	(A) Expected genotype for 4 offspring	(B) Expected genotype for 100 offspring	(C) Toss results	(D) Observed genotype for 100 offspring
RR				
Rr or *rR*				
rr				

6. Assume that R represents the dominant gene for normal skin pigment. Assume that r represents a recessive condition called albinism, no skin pigment. From your punnett square list in column A of Table 2. the phenotypes expected.
7. Calculate the number expect to have each trait if there are 100 offspring. Record these numbers in column B.
8. From your data in column D, total and record in column C of Table 2. the number of offspring who will have normal pigment and those who will be albino.

Table 2. Expected and Observed Phenotypes

Phenotype possible	(A) Expected phenotype for 4 offspring	(B) Expected phenotype for 100 offspring	(C) Observed phenotype for 100 offspring
Normal skin			
Albino			

Analysis

1. (a) What is meant by expected genotypes? _____

   (b) Are expected results due to chance or are they arrived at mathematically? _____

2. (a) What is meant by observed genotypes? _____

   (b) Are observed results due to chance or are they arrived at mathematically? _____

3. What does each coin represent in this investigation? _____

4. How does the chance of a coin landing on each side compare to the chance that a gamete cell will receive a particular gene at meiosis? _____

5. (a) Why must two coins be used to determine the genotypes for the offspring? _____

   (b) What does the use of two coins compare to at fertilization? _____

6. Compare the expected genotypes of 100 offspring with the observed genotypes.

   (a) Do they agree or disagree? _____

   (b) If they disagree, how much do they disagree? _____

7. (a) Are your results wrong if they do not agree? _____

   (b) Explain. _____

8. What is the advantage of comparing the 100 expected offspring with the 100 observed offspring rather than comparing only four expected offspring with four observed offspring? _____

9. Compare the expected phenotypes for 100 offspring with the observed phenotypes.

   (a) Do they agree or disagree? _____

   (b) If they disagree, how much do they disagree? _____

10. (a) Are your results wrong if they do not agree? _____

    (b) Explain. _____

11. If expected and observed results are never in close agreement, then our understanding of the law of dominance and the chance combination of genes cannot be correct.
    (a) Are expected and observed results in close agreement after many offspring are counted?

    (b) Does our understanding of genetics seem to have support as illustrated in this investigation?

    (c) Would you have good evidence if only one or two offspring were examined? _____

    (d) Explain. _____

Mendel's Monohybrid Cross

Practise solving genetics problems involving monohybrid crosses.

What To Do

Answer each question in the space provided. Use an extra piece of paper to draw your Punnett squares.

1. Inflated pea pods are dominant (C) over constricted pea pods (c).
   (a) Give the genotypes and phenotypes of a cross between a plant homozygous dominant and a plant that is homozygous recessive.

   _____

   (b) Cross two plants from the first filial generation, and determine the genotypes and phenotypes of the offspring that result.

   _____

2. Pod colour green is dominant (G) over yellow colour (g).
   (a) Give the genotypes and phenotypes of a cross between a plant homozygous dominant and a plant that is homozygous recessive.

   _____

   (b) Cross two plants from the first filial generation, and determine the genotypes and phenotypes of the offspring that result.

   _____

3. Tall pea plants are dominant (T) over short pea plants (t).
   (a) Give the genotypes and phenotypes of a cross between a plant homozygous dominant and a plant that is heterozygous for plant size.

   _____

   (b) Cross two heterozygous plants from the first filial generation, and determine the genotypes and phenotypes of the offspring that result.

   _____

4. Detached earlobes are dominant (E) over attached earlobes (e). Give the genotypic ratio of a cross between two individuals heterozygous for earlobe shape.

   _____

Mendel's Monohybrid Cross (continued)

5. A widow's peak hairline is dominant (H) over a smooth hairline (h). If a homozygous dominant individual mates with a homozygous recessive individual, give the phenotypic ratio of the second filial generation offspring.

6. Curly hair is dominant (C) over straight hair (c). Is it possible for a curly haired man to produce curly haired children if his wife has straight hair? Explain in the space below, using Punnett squares.

Beyond Mendel's Laws

1. Human Blood Types:

Table 1.A

PHENOTYPE (blood type)	GENOTYPE
A	I^AI^A or I^Ai
B	I^BI^B or I^Bi
AB	I^AI^B
O	ii

a. If a woman has blood type AB and a man has blood type A, what possible blood types will their children have? Refer to Table 1.A for standard blood type phenotypes and genotypes.

b. A man has blood type A and his wife has blood type B. A child has blood type O. Could these individuals be the parents of this child? Give proof.

c. Suppose a man with blood type B has children with a woman whose blood type is AB. What blood types could you expect to find among their children? What could tell you if the man was homozygous or heterozygous for the B blood type?

2. Incomplete Dominance, Co-dominance and Multiple Alleles:

a. In foxes, a pair of alleles interact as follows: **PP** is lethal (usually during the embryonic stage); **Pp** produces platinum-coloured fur, and **pp** produces silver foxes. Could a fox breeder establish a true-breeding variety of platinum foxes? Explain.

b. Coat colour in rabbits is governed by four different alleles, as seen in Table 2.B.

PHENOTYPE (coat colour)	ALLELE	PATTERN OF INHERITANCE
Dark grey	C	Dominant over all other alleles
Chinchilla	c^{ch}	Dominant to Himalayan and white
Himalayan	c^h	Dominant to white
White	c	recessive

i. List all the possible genotypes for a dark grey rabbit, a Chinchilla rabbit, a Himalayan rabbit, a white rabbit.
ii. Predict the phenotype of the rabbits with the following genotypes: $c^h c^{ch}$ and Cc^h
iii. Would it be possible to obtain white rabbits if one parent is white and the other is chinchilla?
iv. A Chinchilla rabbit is mated with a Himalayan. Some of the offspring are white. What are the parents' genotypes?

c. In four o'clock plants, red flowers are incompletely dominant over white flowers. The heterozygous flowers are pink. If a red-flowered plant is crossed with a white-flowered plant, what will be the flower colour of the:
F_1 generation?
F_1 generation crossed with its red parent?
F_1 generation crossed with its white parent?