

LAB 5: CELL DIVISION AND GENETICS



Today we'll take a look at the stages of mitosis, using microscope slides of real cells in the process of division. We'll also consider some applications of genetics by reviewing concepts and problem sets together. Remember that genetics today is of crucial importance not just to ourselves, but to all the species depending on us for their very survival. Genetics plays a vital role in conservation biology, and genetic variability is a key to species conservation. Lack of genetic variability (following a genetic bottleneck, for example) renders species less capable of dealing with environmental changes and may doom some species to extinction. We also use forensic DNA analysis in cases of illegal harvest of endangered species and/or products (such as rhino horn, elephant tusks, medicinals derived from tigers, bears, etc.).

CELL DIVISION IN PLANTS & ANIMALS

We examined diagrams of cell division in lecture, but it's always nice to look at the real thing too. Working with your lab partner, take a microscope and the slides of *Allium* (onion) root tip and whitefish blastula to your desk. Remember the protocols we used for setting up the 'scope and viewing of slides. Also examine the posters/models of mitosis on the side counter to refresh your memory of what happens in each stage of division.

Hints for the *Allium* root tip slide: Start at low power (4X) and center the tip of the root in your field of view. Get it into clear focus. It's the region just above the root tip that you want to concentrate on, as this region contains cells which are dividing rapidly in living plants and will therefore have cells in all stages of mitosis clearly visible. Increase magnification (do not try to use the oil immersion lens, though) so that you can examine individual cells. Can you ID cells in the major mitotic stages? Sketch them below as labeled.

Hints for the whitefish blastula slide: The whitefish is a fish, so an animal. How do its cells differ from that of the onion (in terms of organelles)? A blastula is a teeny ball of cells found during very early embryological

development, and its cells are very busy dividing mitotically, producing daughter cells of like DNA. The blastula appears under the 'scope as a pale pink circle (stained to bring out individual cells' chromosomes). That circle is composed of many many individual cells—it is not a single cell! So once you have a blastula centered in your field of view and focused clearly, increase the magnification so that you can make out single cells. Can you determine in which mitotic stages these cells are? Good! Sketch each stage as you see it below.

Sketch a plant and an animal cell in each of the following stages:

	ONION ROOT CELL	WHITEFISH BLASTULA
LATE PROPHASE:		
METAPHASE:		
ANAPHASE:		
TELOPHASE:		

GENETICS CONCEPTS, PROBLEMS AND APPLICATIONS

We worked out some problems together in lecture already, but the more practice, the better! Work together with your lab partner on the questions below; if you are uncertain about technique and/or applications, call your instructor over to help out.

1. What are the two types of cell division, and what are the general purposes of each?
2. Where in the bodies of animals does each type of cell division occur?
3. How do the products of the two cell division types differ?
4. How does sexual reproduction favor diversity?
5. If a species, or a population within a species, is reduced in numbers (particularly if the survivors are related closely), why is it likely that their survival will be compromised even though numbers may rise again?

BIO10 Genetics Assignment

Student Name _____ Section: _____

_____ points. Must be completed and handed in by _____

- ☐ Genetics Problems
- ☐ PART I: Practice Problems. Do all.
- ☐ PARTII: Multiple Choice: Choose 10 problems. Each worth 1 point.

1. Show all the different kinds of gametes which could be produced by the following individuals:

a) aa

b) Bb

c) AA

d) TTRR

e) CcDd

f) AABb

g) Aabb

h) aabb

i) CCDdee

j) AaBbCc

2. In dogs, wire hair is due to a dominant gene (W) and smooth hair is due to its recessive allele (w).

a) If a homozygous wire-haired dog is mated with a smooth haired dog, what type of offspring could be produced?

b) What type of offspring could be produced in the F₂?

c) Two wire-haired dogs are mated. Among the offspring of their first litter is a smooth-haired pup.

- If these two wire-haired dogs mate again, what are the chances that they will produce another smooth-haired pup?

- What are the chances the pup will be wire-haired?

d) A wire-haired male is mated with a smooth-haired female. The mother of the wire-haired male was smooth haired. What are the phenotypes and genotypes of the pups they could produce?

3) In snapdragons, red flower color is completely dominant over white flower color. The heterozygous plants have pink flowers.

a) If a red-flowered plant is crossed with a white-flowered plant, what are the genotypes and phenotypes of the plants of the F1 generation?

b) What genotypes and phenotypes can be produced in the F2 generation?

c) What kinds of offspring can be produced if a red-flowered plant is crossed with a pink flowered plant?

d) What kinds of offspring can be produced if a pink flowered plant is crossed with a white flowered plant?

4. In humans, the presence of freckles is due to a dominant gene (F) and the non-freckled condition is due to its recessive allele (f). Dimpled cheeks (D) is dominant to non-dimpled cheeks (d). Two persons with freckles and dimpled cheeks have 2 children. One has freckles but no dimples and one has dimples but no freckles.

a) What the genotypes of the parents?

b) What are the possible phenotypes and genotypes of the children which they could produce?

c) What are the chances that they would have a child which lacks both freckles and dimples?

d) A person with freckles and dimples whose mother lacked both freckles and dimples marries a person with freckles but no dimples (whose father did not have freckles or dimples). What are the chances that they would have a child which lacks both freckles and dimples?

5. In humans, colorblindness is a recessive, sex-linked trait.

a) Two normal people have a colorblind son. What are the genotypes of the parents and what genotypes and phenotypes are possible among their children?

b) A couple has a colorblind daughter. What are the possible genotypes and phenotypes of the parents and the daughter?

Multiple Choice. ANSWER ONLY 10 of the following questions.

1. The genetic cross between a homozygous recessive individual and one of an unknown genotype is referred to as

- a) self cross
- b) test cross
- c) hybrid cross
- d) F1 cross
- e) dihybrid cross

2. In crossing a homozygous recessive with a heterozygote, what is the chance of getting a homozygous recessive phenotype in the F1 generation?

- a) 0
- b) 25%
- c) 50%
- d) 75%
- e) 100%

3. In snapdragons, heterozygotes have pink flowers, whereas homozygotes have either red or white flowers. When plants with red flowers are crossed with plants with white flowers, what proportions of the offspring will have pink flowers?

- a) 0 b) 25% c) 50% d) 75% e) 100%

4. Black fur in mice (B) is dominant to brown fur (b). Short tails (T) is dominant to long tails (t). What proportion of the progeny of the cross BbTt x BBtt will have black fur and long tails?

- (a) 1/16; (b) 3/16; (c) 6/16; (d) 8/16; (e) 9/16.

5. A couple has three children, all of whom have brown eyes and blond hair. Both parents are homozygous for brown eyes (BB), and one is blond (rr) while the other is a redhead (Rr). What is the probability that the next child will be a brown-eyed redhead?

- a) 1/16 b) 1/8 c) $\frac{1}{4}$ d) $\frac{1}{2}$ e) 1.

6. A 9:3:3:1 phenotypic ratio is characteristic of the:

- (a) F2 generation of a monohybrid cross;
- (b) F2 generation of a monohybrid cross
- (c) F1 generation of a dihybrid cross;
- (d) F2 generation of a dihybrid cross;
- (e) F2 generation of a trihybrid cross.

7. How many unique gametes could be produced through independent assortment by an individual with the genotype AaBbCCDdEE?

- a) 4 b) 8 c) 16 d) 32 e) 1/64.

8. In cattle, roan coat color (mixed red and white hairs) occurs in the heterozygous (Rr) offspring of red (RR) and white (rr) homozygotes. When two roan cattle are crossed, the phenotypes of the progeny are found to be in the ratio of 1 red : 2 roan : 1 white. Which of the following crosses could produce the highest percentage of roan cattle?

- a) red x white
- b) roan x roan
- c) white x roan
- d) red x roan
- (e) all of the above crosses would give the same percentage of roan.

9. Roan color in cattle is the result of the absence of dominance between red and white color genes. How would one produce a herd of pure-breeding roan-colored cattle?

- a) cross roan with roan b) cross red with white
- c) cross roan with red d) cross roan with white e) it cannot be done.

10. An animal has the genotype $AaBbCcDd$. Relative to these four linked loci, how many unique kinds of gametes can be produced by this individual?

- a) 1
- b) 2
- c) 4
- d) 8
- e) 16.

11. In some cats, black color is due to a sex-linked (X-linked) recessive gene (b); the dominant allele (B) produces orange color. The heterozygote (Bb) is calico. What kinds of offspring would be expected from the cross of an orange male and a black female?

- (a) black females & orange males
- b) orange females & black males
- c) calico females & black males
- d) black females & calico males
- e) orange females and orange males.

12. People who have red hair usually have freckles. This can best be explained by: a) linkage

b) reciprocal translocation

c) independent assortment

d) sex-influenced inheritance

e) nondisjunction.

13. If a woman who is red-green color blind mates with a man with normal vision, what phenotypes would one expect their children to have?

(a) all their children would be color blind

b) all their daughters would be color blind, but their sons would have normal vision

c) all their daughters would be carriers and all their sons would be color blind

d) all their daughters would have color vision and would not be carriers

e) half their daughters would be carriers and the other half would be fully normal, while half their sons would be color blind and the other half would have normal vision.