Lab 10: Module 07–10 Review — Genetics, Cell Division, Tissues & Inheritance

BIOL-8

Name: _____ **Date:** _____

Name: **Date:**

Section: **Lab Partner(s):**

Purpose

This lab is a structured, paper-based review to prepare you for **Exam 02**, which covers:

Module	Topic	Key Concepts
07	Genetics & DNA	DNA structure, replication, transcription, translation, mutations
08	Cell Division	Mitosis, meiosis, the cell cycle, comparison of both processes
09	Tissues	Four tissue types, structure-function relationships, locations
10	Inheritance	Mendelian laws, Punnett squares, pedigrees, sex-linked traits

> ***How to use this lab:*** *Work through each section systematically. The activities progress from recall → application → analysis → synthesis. Complete all fill-in tables and reflection questions honestly — this is practice for the exam.*

Part 1: Module 07 — Genetics & DNA

1A. Core Vocabulary Check

Fill in the blank with the correct term:

Module 07 Vocabulary

#	Definition	Term
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

1B. DNA Structure Diagram

In the space below (or on scratch paper), **sketch a short segment of DNA** (at least 4 base pairs) and label:

- Sugar-phosphate backbone
- Hydrogen bonds
- At least two correctly paired bases (A-T and G-C)

After sketching, answer: Why is the DNA double helix described as "antiparallel"?

Why does accurate base pairing matter for DNA replication?

1C. Central Dogma Flow

Complete the flow chart by filling in the blanks:

```
DNA  ——————————→  _________  ——————————→  _________
       (Transcription)            (Translation)

Location: _________              Location: _________
```

A mutation changes a codon from CAU to CAA. Both code for different amino acids. What type of mutation is this (silent, missense, or nonsense)?

Why can a single point mutation sometimes have no effect on the final protein?

Part 2: Module 08 — Cell Division

2A. The Cell Cycle

Label the phases of the cell cycle in the diagram below by completing the table:

Cell Cycle Phases

#	Phase	What Happens	Is the Cell Dividing?
1			
2			
3			
4			
5			
6			

2B. Mitosis Phase Sequencing

Cut and arrange (or simply number 1–6 in order) the following events:

Order the Events of Mitosis

#	Event	Order (1–6)
1		
2		
3		
4		
5		
6		
7		

2C. Mitosis vs. Meiosis Comparison

Comparing Mitosis and Meiosis

#	Feature	Mitosis	Meiosis
1			
2			
3			
4			
5			
6			
7			
8			
9			

Why must meiosis produce haploid cells? (Think about what happens at fertilization.)

Name two ways meiosis generates genetic variation:

1.
2.

2D. Chromosome Counting Practice

Use the following starting cell: **diploid organism, 2n = 6** (3 homologous pairs).

Chromosome Counts Through Division

#	Stage	Number of Chromosomes per Cell	Number of Cells	Total Chromatids
1				
2				
3				
4				
5				

Part 3: Module 09 — Tissues

3A. The Four Tissue Types

Four Primary Tissue Types

#	Tissue Type	Primary Function	Key Characteristic	Example Location in Body
1				
2				
3				
4				
5				

3B. Epithelial Tissue Classification

Epithelial tissue is classified by two features: **shape** (squamous/cuboidal/columnar) and **layers** (simple/stratified/pseudostratified).

Epithelial Tissue Types

#	Epithelial Type	Shape	Layers	Location / Function
1				
2				
3				
4				
5				
6				

3C. Connective Tissue Variety

Match each connective tissue type to its defining feature and location:

Connective Tissue Types

#	Connective Tissue	Defining Feature	Location
1			
2			
3			
4			
5			
6			

3D. Tissue Identification Scenarios

For each description, identify the most likely tissue type and subtype:

1. You observe cells that are flat and scale-like, arranged in a single layer lining the inside of a blood vessel. What tissue is this?

2. You observe long, cylindrical, multinucleated cells with visible striations (stripes). This tissue is:

3. You observe cells scattered in a gel-like matrix with abundant collagen fibers running in all directions. This is most likely:

4. A tissue sample shows branching, involuntary cells with intercalated discs connecting them. This is:

5. A tissue with cells that have long processes (axons and dendrites) embedded in a matrix of support cells (glia). This is:

3E. Structure-Function Synthesis

Why does the intestinal lining use simple columnar epithelium rather than stratified squamous epithelium? (Hint: think about absorption vs. protection.)

The trachea (windpipe) is lined with pseudostratified ciliated columnar epithelium. What function do the cilia serve, and why is this important for lung health?

Part 4: Module 10 — Inheritance

4A. Mendel's Laws

Fill in the blanks:

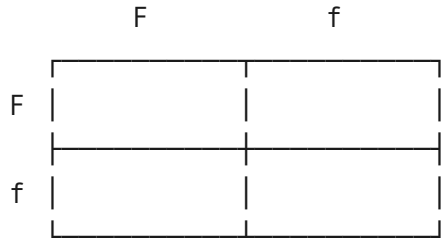
Mendel's Laws

#	Law	Statement	What It Predicts
1			
2			
3			

4B. Monohybrid Cross Practice

Scenario: Freckles (F) are dominant over no freckles (f). Two heterozygous parents (Ff × Ff) have children.

1. Complete the Punnett square:



What fraction of offspring will have freckles?

What fraction will be homozygous recessive (ff)?

What is the genotypic ratio (AA : Aa : aa)?

What is the phenotypic ratio (dominant : recessive)?

4C. Dihybrid Cross

Scenario: Smooth skin (S) is dominant over rough (s). Brown eyes (B) is dominant over blue (b). Two parents heterozygous for both traits cross: **SsBb × SsBb**.

List all possible gametes each parent can produce:

Using the 9:3:3:1 ratio, out of 16 offspring, how many would you expect to be:

- Smooth skin AND brown eyes: _____ / 16
- Smooth skin AND blue eyes: _____ / 16
- Rough skin AND brown eyes: _____ / 16
- Rough skin AND blue eyes: _____ / 16

If the genes for skin texture and eye color are on the same chromosome (linked), would independent assortment still apply? Explain:

4D. Pedigree Analysis

The following family has a history of cystic fibrosis (CF). CF is **autosomal recessive** (let C = normal allele, c = CF allele).

```
                                  |
Generation III:                   □    ○
```

Legend: □ = unaffected male, ○ = unaffected female, ● = affected female. Lines between individuals indicate mating; vertical lines indicate offspring.

The shaded individual in Generation II has CF. What is her genotype?

What must the genotypes of her parents (Generation I) be?

Her unaffected brother in Generation II marries an unaffected woman with no family history. What is the probability that their child (Generation III) will have CF? Show your reasoning.

Could CF appear in Generation III even if neither parent is known to be a carrier? Explain:

4E. Sex-Linked Inheritance

Key Rule: Genes on the X chromosome follow X-linked inheritance. Males (XY) only have one copy of X-linked genes, so they express whatever allele is present.

Scenario: Color blindness is **X-linked recessive** (X^B = normal vision, X^b = color blind).

Cross: Carrier female (X^B X^b) × Normal male (X^B Y)

Complete the Punnett square:

```
          X^B          Y
      ┌──────────┬──────────┐
```

What is the probability of a color-blind son?

What is the probability of a color-blind daughter?

Why are males much more commonly affected by X-linked recessive conditions than females?

In hemophilia (also X-linked recessive), could a daughter be affected? Under what circumstances?

Part 5: Integration — Connecting the Modules

5A. Cross-Module Concept Map

On your scratch paper, **draw a concept map** (or complete the partial map below) that shows how the four modules are connected. Key relationships to include:

- DNA (Module 07) → controls cell function → required for cell division (Module 08)
- Cell division (Module 08) → meiosis → produces gametes → enables inheritance (Module 10)
- Inheritance (Module 10) → determines which genes are expressed → affects tissue development (Module 09)

- Mutations in DNA (Module 07) → can disrupt the cell cycle (Module 08) → can alter tissue type or function (Module 09)

In your own words, explain how a single mutation in a DNA repair gene (Module 07) could ultimately lead to uncontrolled cell division (Module 08). What is the medical term for this condition?

Sickle cell disease is caused by a single point mutation (Module 07). It is inherited recessively (Module 10). The abnormal hemoglobin causes red blood cells to sickle and clog capillaries. This affects which tissue types (Module 09)?

5B. Exam Readiness Self-Assessment

Rate your confidence on each topic (1 = need more study, 5 = very confident):

Exam Readiness Check

#	Topic	Confidence (1–5)	One Question I Still Have
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

5C. Final Synthesis Questions

1. What is the relationship between meiosis and Mendel's Law of Independent Assortment? (Which stage of meiosis directly explains this law?)

2. A cell has 2n = 46 chromosomes. After meiosis I is complete, how many chromosomes are in each cell? After meiosis II? Are these chromosomes duplicated (as sister chromatids) or single-stranded at those points?

3. Two parents are both carriers (heterozygous) for an autosomal recessive condition. They have 4 children. Predict how many children you would expect to be affected. Does this mean exactly that number will be affected? Why or why not?

4. Explain why stratified squamous epithelium is well-adapted for the skin (outer epidermis) but would be a poor choice for lining the lungs' alveoli (air sacs).

5. BONUS — Critical Thinking: A woman is a carrier for an X-linked recessive condition. Her sister is also a carrier. They each have one son. For each son, what is the probability of being affected? If both sons are affected, is that evidence of a genetic link between the brothers, or just chance? Explain.

Quick Reference: Key Formulas & Rules

Concept	Rule / Formula
Independent assortment combinations	2^n (where n = number of chromosome pairs)
Punnett square offspring types	Monohybrid: 4 boxes; Dihybrid: 16 boxes
Diploid (2n) after mitosis	Still 2n
After meiosis I	n chromosomes (duplicated)
After meiosis II	n chromosomes (single-stranded)
X-linked recessive in males	Only one X needed for expression

Concept	Rule / Formula
X-linked recessive in females	Two recessive alleles needed
Carrier (heterozygous) phenotype	Dominant phenotype (does not show recessive trait)

Connection to Exam 02: This lab directly maps to all content on Exam 02 (Modules 07–10). If you can answer every question on this worksheet without looking at your notes, you are well prepared.

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