

Entering 10th Grade Honors Biology

Reading, Ethics, History, and Foundational Cell Biology Packet

Welcome to Honors Biology! This summer, your assignment bridges history, bioethics, and fundamental molecular biology through the lens of Rebecca Skloot’s award-winning non-fiction book, *The Immortal Life of Henrietta Lacks*.

Henrietta Lacks was a Black tobacco farmer whose cervical cancer cells—taken without her knowledge or consent in 1951—became one of the most vital tools in modern medicine. Known globally as **HeLa**, these cells have lived on for decades in laboratories worldwide, enabling the polio vaccine, cloning, gene mapping, and in vitro fertilization, all while raising profound questions about race, ethics, and patient rights.

Instructions: Complete this packet in its entirety before the first day of classes. This work will serve as your first major grade and will form the basis of our opening unit's seminar and laboratory discussions.

Part 1: Guided Reading & Bioethical Reflections

As you read *The Immortal Life of Henrietta Lacks*, reflect deeply on how historical context, social structures, and scientific drive intersected. Answer the following questions thoroughly.

Section A: The History & Science of HeLa

1. Describe the circumstances under which Henrietta Lacks’s cells were collected at Johns Hopkins Hospital in 1951. Who extracted them, and what unique biological characteristic made these cells behaviorally different from any human tissue culture previously attempted?

2. Identify three distinct global medical or scientific breakthroughs made possible specifically due to the replication and distribution of HeLa cells. Explain how these cells laid the early groundwork for modern genetic research.

3. Contrast the commercial multi-billion dollar success of the biotechnology industry built upon HeLa cells with the material reality, financial status, and healthcare access experienced by Henrietta's living descendants.

Section B: Bioethics & Legal Horizons

4. Define the modern medical standard of "informed consent." Given the cultural and legal environment of clinical research in 1951, do you judge the medical professionals to have acted maliciously, or were they merely adhering to contemporary societal norms? Support your judgment with evidence.

5. Decades after Henrietta's passing, researchers published the full genomic sequence of the HeLa cell line online without consulting or seeking permission from the Lacks family. Why does publishing an individual's complete genetic profile pose significant ethical and privacy challenges for their living blood relatives?

Part 2: Essential Biology Review

To establish a rigorous framework for honors-level cellular study, review the following prerequisite concepts spanning cell types, membrane dynamics, and cell cycle regulation.

1. Comparative Cytology: Prokaryotes vs. Eukaryotes

All cellular life is fundamentally bifurcated into two organizational domains based on structural complexity. HeLa cells are human cells, positioning them firmly within the eukaryotic lineage.

STRUCTURAL FEATURE	PROKARYOTIC CELLS	EUKARYOTIC CELLS
Location of Genetic Material (DNA)	Freely floating in the cytoplasm (nucleoid)	Housed securely inside a distinct, membrane-bound _____
Membrane-Bound Organelles (e.g., Mitochondria, ER)	Absent	_____ _____
Average Size & Complexity	_____ and Simple	Large and Complex
Conserved Structures (Present in both lineages)	Cell membrane, cytoplasm, DNA, and _____	Cell membrane, cytoplasm, DNA, and _____
Evolutionary Examples	Bacteria and Archaea	Plants, Animals (e.g., HeLa), Fungi, Protists

Critical Analytical Question:

Why did early mid-century scientists find it drastically more difficult to sustain and cultivate *eukaryotic* human tissue in a laboratory environment compared to growing simple *prokaryotic* bacterial cultures?

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2. Cellular Border Dynamics: Passive vs. Active Membrane Transport

For an isolated tumor cell line to proliferate endlessly in vitro, it must continuously import metabolic fuels across its semi-permeable plasma membrane and export toxic waste solutions.

Mechanism A: Passive Transport (No Energy Expenditure)

Molecules drift **down** their concentration gradient, transitioning naturally from an area of **HIGH** concentration to an area of **LOW** concentration until dynamic equilibrium is established.

- **Simple Diffusion:** Small, nonpolar molecules navigate directly through the phospholipid bilayer (e.g., **O₂** and **CO₂**).
- **Facilitated Diffusion:** Larger or highly polar entities pass down gradients via specialized transmembrane channel or carrier proteins.
- **Osmosis:** The targeted passive net movement of _____ across a selectively permeable membrane.

Mechanism B: Active Transport (Energy Investment Required)

Molecules are actively driven **against** their electrochemical gradient, forced from an area of **LOW** concentration into an area of **HIGH** concentration. This requires specialized metabolic cellular machinery.

- **Adenosine Triphosphate (ATP):** The fundamental currency utilized by the cell to physically drive transmembrane transport proteins.
- **Bulk Transport:** Large macromolecular payloads are moved utilizing vesicles:
 - *Endocytosis:* Folding inward to ingest extracellular cargo.
 - *Exocytosis:* Vesicles fusing outwards to expel cellular products.

Transport Quick-Check Questions:

a) If a HeLa sample is placed in an extracellular solution featuring an elevated salt concentration, cellular water rapidly exits into the surroundings, causing the cell to undergo crenation (shriveling). Is this active or passive? Identify the explicit physical process taking place.

b) Malignant cancer cells require massive quantities of glucose to sustain rapid mitotic division. If the internal cytoplasm of a HeLa cell contains a significantly higher concentration of glucose than the surrounding laboratory growth media, which category of transport must the cell deploy to extract further glucose from its environment?

3. The Eukaryotic Cell Cycle & Mitosis

The defining trait of Henrietta Lacks's cells is their ability to continually override standard senescence and replicate indefinitely. Review the baseline stages governing a standard cell cycle.

CELL CYCLE PHASE	SYMBOL	PRINCIPAL CELLULAR ACTIVITY
Gap 1 Phase	G_1	Active growth phase: cell increases mass, synthesizes essential metabolic proteins, and replicates somatic organelles.
Synthesis Phase	S	Replication of the nuclear genome; identical sister chromatids are synthesized, doubling total cellular DNA volume.
Gap 2 Phase	G_2	Final proofreading checkpoints ensure error-free replication; production of mitotic structures (e.g., spindle fibers).
Mitosis	M	Nuclear division: precise sorting and separation of the duplicated chromosomes into two distinct polar regions.
Cytokinesis	—	Physical cleavage of the cytoplasm, separating one parent cell into two individual, genetically identical daughter units.

Provide a brief, precise structural description detailing the orientation and movement of chromosomes during each distinct sub-phase of Mitosis:

- Prophase:
- Metaphase:
- Anaphase:
- Telophase:

4. The Cellular Onset of Oncogenesis (Cancer)

Healthy human somatic tissue displays a definitive proliferative threshold known as the *Hayflick Limit*, meaning cells stop dividing and undergo programmed cell death (**apoptosis**) after roughly 40 to 60 replication events.

6. Given your understanding of the normal cell cycle outlined above, define what cancer fundamentally represents at a cellular level, and explain how a cell's failure to respect regulatory regulatory checkpoints leads to tumor growth.

7. Research the specialized enzyme known as telomerase. Explain its mechanical function during DNA replication and clarify why abnormally elevated telomerase activity explains why HeLa cells bypass cellular mortality.

Part 3: Synthesis Essay Preparation Outline

During the first academic week of the semester, you will draft an in-class, timed synthesis essay. Use this designated page to outline your textual evidence and construct a working thesis statement based on the core analytical prompt below.

Core Essay Prompt: *Scientific innovation frequently progresses at a velocity that eclipses the regulatory laws and ethical systems meant to manage it. Utilizing evidence from Henrietta Lacks's narrative alongside your biological knowledge of cellular processes, argue whether the immense global medical advancements gained via unauthorized tissue research justify the systematic violation of historic patient autonomy and individual rights.*

My Working Thesis Statement:

Evidence Point 1: Scientific/Cellular Framework (e.g., HeLa immortality, vaccines, genetics)

Evidence Point 2: Historical/Ethical Framework (e.g., informed consent, socioeconomic conditions, privacy)



Student Submission Checklist

Ensure you have verified each requirement below before submitting this document on your first day of class:

- ☐ Comprehensive reading of *The Immortal Life of Henrietta Lacks* completed.
- ☐ Completed long-form analytical answers to all guided reading prompts in Part 1.
- ☐ Filled in all missing vocabulary terms and structural matrices within the Part 2 review.

- ☐ Outlined a cohesive thesis statement and cataloged supporting textual citations in Part 3.