Modern American Journal of Linguistics, Education, and Pedagogy
ISSN (E): 3067-7874
Volume 01, Issue 03, June, 2025
Website: usajournals.org

SEMANTIC HIERARCHIES IN BIOTECHNOLOGY TERMINOLOGY: A STUDY OF HYPER-HYPONYMIC RELATIONS IN ENGLISH AND UZBEK

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Abstract

This article explores hyper-hyponymic relations as one of the core paradigmatic structures in biotechnology terminology. Drawing on theoretical insights from linguistics and terminology studies, it classifies various semantic relationships such as general–specific concepts, class–member, parameter–carrier, process–object, and property–object. Examples from both English and Uzbek demonstrate how these hierarchical relations organize and clarify scientific knowledge. The study reveals that biotechnology terminology forms multi-level, intersecting taxonomies, where a term may function as a hyponym in one context and a hypernym in another. The findings contribute to a deeper understanding of systematicity in specialized language and provide a linguistic basis for more effective terminology development, translation, and interdisciplinary communication.

Keywords: Terminology, hyponymy, biotechnology, systematicity, taxonomy, semantics, hyper-hyponymic relations, semantic hierarchy

Introduction.

The language system consists of complex interrelations among levels that are interconnected and interdependent. H. Ne'matov and R. Rasulov identify the following three types of relations: 1. Similarity (paradigmatic) relations; 2. Hierarchical (tiered) relations; 3.Adjacency (syntagmatic) relations.[1]

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A. Nurmonov classifies these relations into two categories:

1. Relations between units belonging to the same level;
2. Relations between units belonging to different levels. [2]

Units belonging to the same level enter into two types of relations: **associative (paradigmatic) relations** and **sequential (syntagmatic) relations.** The grouping (nesting) of equivalent units belonging to the same level into one group based on a common feature is considered a paradigmatic relation. In defining the paradigmatic relation of linguistic units, the criterion of **semantic commonality** most often plays a key role. It is well known that the terms included in the terminology of various fields of knowledge are not artificially created units, but rather elements of the natural language system. Therefore, terminology is also subject to the fundamental general linguistic lexical-semantic processes such as **homonymy, polysemy, synonymy, antonymy, hyponymy,** and **hypernymy.**

Research Methods

This study uses a descriptive and comparative linguistic approach to analyze hyper-hyponymic relations in English and Uzbek biotechnology terminology. Terminological data were collected from scientific articles, textbooks, and glossaries covering fields such as genetic engineering, molecular biology, and biochemistry.

Terms were examined based on their semantic roles, structural features, and hierarchical functions. Special focus was placed on identifying multi-level (two- to four-tier) hyper-hyponymic chains. The analysis was guided by theories from terminology studies and lexical semantics, particularly the works of S. Grinev and E. Wüster.

Results and Analysis

From a semantic point of view, one of the important paradigmatic relations is the hyper-hyponymic relationship. According to S. Grinev, these relationships exist "between a general concept with a broader meaning (the genus) and narrower, specific concepts (the species) that fall under it."[3] These relationships are characterized by "logical-semantic subordination, differential oppositions, corresponding concepts, and included distributions."[4] Hyponyms represent

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specific (species-level) concepts, while hypernyms represent general (genus-level) concepts.[5] The main functions of hyponyms are to systematize terminology, explain meanings, and generalize and clarify through specific distinguishing features.[6]

The main characteristics of **hyponyms** are manifested in the following aspects:

1. A hyponym is identified based on the principle of unidirectional implication—that is, a hyponym can always be replaced by its hypernym, since the specific concept is subordinate to the general one. However, the reverse substitution is not always possible.
2. The meaning of a hyponym is semantically more complex and richer, while the class of objects it describes is narrower in scope.
3. Semantic relations among co-hyponyms reflect the relationships between elements within the same category. Hyponyms incorporate the meaning of their hypernym and are contrasted with one another through additional differential semantic features.[7]

Based on hyper-hyponymic relations, biotechnology terminology is divided into the following types of semantic connections:

General concept – specific concept. For instance, terms such as *Genetically modified organism (GMO) – Genetik o'zgartirilgan organism*, *GM plants – GM o'simliklar* (herbicide- or pest-resistant), *GM animals – GM hayvonlar* (transgenic animals for pharmaceutical production), and *GM microorganisms – GM mikroorganizmlar* (bacteria for insulin production) represent specific concepts. Similarly, the hyperonym *cell (hujayra)* corresponds to the hyponyms *Somatic Cell (somatic hujayra)*, *Germ Cell (jinsiy hujayra)*, and *Stem Cell (ildiz hujayra)*.

Class–member of the class. This type of relationship can be observed in how the meanings of the given terms are connected: *Virus* and *DNA virus (DNK virusi)*, *RNA virus (RNK virusi)*; *protein (oqsil)*, *transport protein – tashuvchi oqsil*, *structural protein – strukturaviy oqsil*.

Parameter–parameter carrier. Such relationships between terms are very common in biotechnology terminology. For example, due to their semantic connection, terms like *Genetic Inheritance (Genetik meros)*, *DNA (DNK)*, *chromosome (xromosoma)*, *gene (gen)*; or *Protein Synthesis (oqsil sintezi)* and

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ribosome (ribosoma), *mRNA (matritsali RNK)*, *tRNA (transport RNK)* are classified as parameter–parameter carrier.

Process–object. This type is directly divided into subtypes such as initial object and final object. For instance, the process: *fermentation – fermentatsiya (achish, bijg'ish)*; initial objects: *sugar (shakar)*, *glucose (glyukoza)*; final objects: *ethanol (etanol)*, *carbon dioxide (Karbonat angidrid)*.

Relation–relation members. This function can be illustrated through the following example: Relation: *Genetic Transformation (genetik transformatsiya)*, relation members: *Host Organism (xost organizm)*, *Transgene (transgen)*. Relation: *Bioremediation (Bioremediatsiya / biotexnologik remediatsiya)*, relation members: *microbial agent (mikrob agent)*, *pollutant (ifloslantiruvchi)*.

Context–science. Terms belong to a specific scientific field. For example, the term *enzyme – ferment* belongs to the field of biochemistry, and *CRISPR* belongs to the field of genetic engineering.

Object of the science–science. In addition to being the names of disciplines that form the basis of biotechnology, all terms in this category also represent the objects studied within these sciences. This function contrasts with the "context–science" relation. For example, the objects of the field of genetics include *heredity (irsiyat)*, *mutation (mutatsiya)*, *gene expression (gen ifodasi)*; the objects of biotechnology include *cell (hujayra)*, *cell culture (hujayra kulturasi)*, *microorganism (mikroorganizm)*; while the objects of microbiology include terms such as *Bacteria (bakteriyalar)*, *Virus (virus)*, *Fungi (zamburug'lar)*.

Property–object relation. This relation reflects the connection between a general property (hypernym) and specific objects (hyponyms) possessing that property. For example, *Pluripotency (Pliyuripotentlik) – Stem Cells (ildiz hujayralari)*; *Selective Permeability (Tanlangan o'tkazuvchanlik) – Plasma Membrane (plazmatik membrana)*.

Linguistic literature distinguishes between formal-semantic and actual semantic hyponymic relations. The analysis of biotechnology-related terms in English and Uzbek shows that most of the terms are "formed through formal-semantic hyponymic relations, often coordinated or uncoordinated with hypernyms expressed by adjectives or nouns, by adding corresponding definitions."[8]

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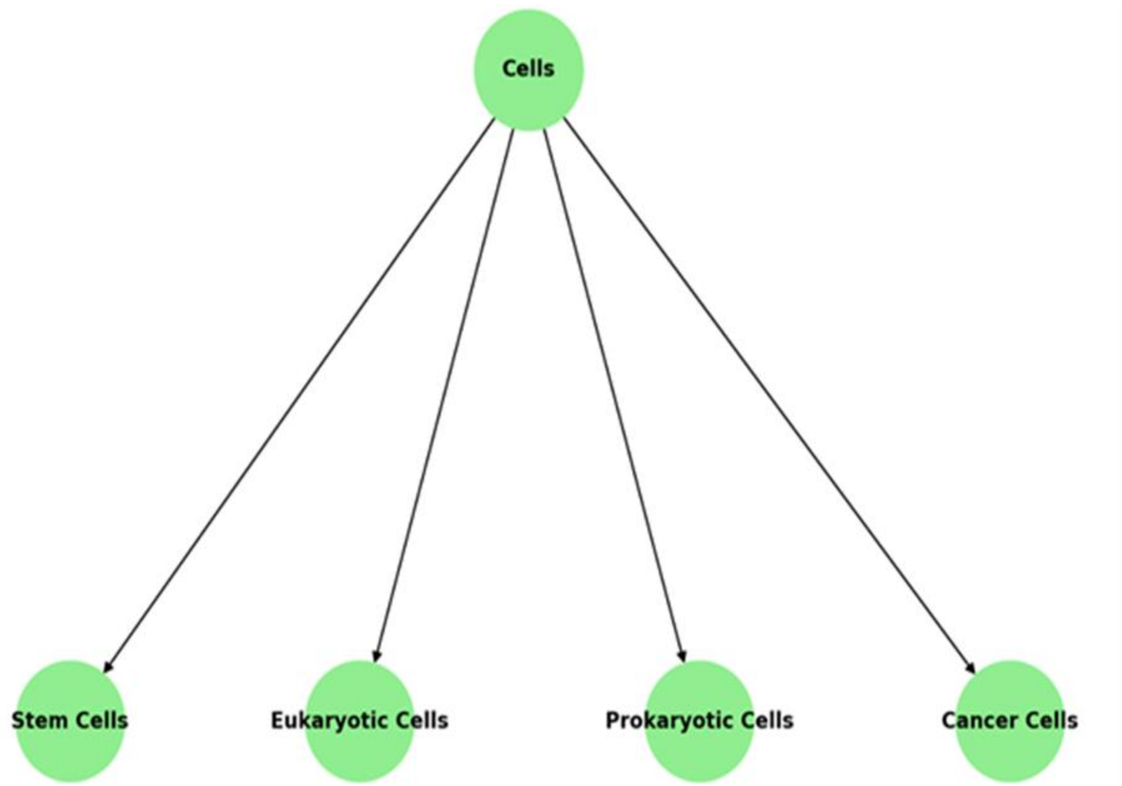
Systematicity is manifested both at the level of logical-conceptual comparison and at the level of lexical and word-formation means. For example, the general term *klonlash (cloning)* generates the following specific hyponyms: *reproduktiv klonlash (reproductive cloning)*, which involves the complete duplication of a human or animal; *terapevtik klonlash (therapeutic cloning)*, used to produce tissues for regenerative purposes; and *gen klonlash (gene cloning)*, aimed at creating exact copies of genetic material. Similarly, the general term *gen (gene)* is divided into the following specific types: *strukturaviy gen (structural gene)* – codes for proteins; *regulyator gen (regulatory gene)* – controls the expression of other genes; and *onkogen (oncogene)* – may lead to uncontrolled cell division. Terminological taxonomies form intersecting, interconnected multi-tiered paradigms. Here, the term is a hyponym of one field and a hypernym of another, confirming the systematicity of general genus-species relations. The analysis of the studied terminology made it possible to identify two-, three-, and four-tier hyper-hyponymic combinations which examples are shown in the following figures:



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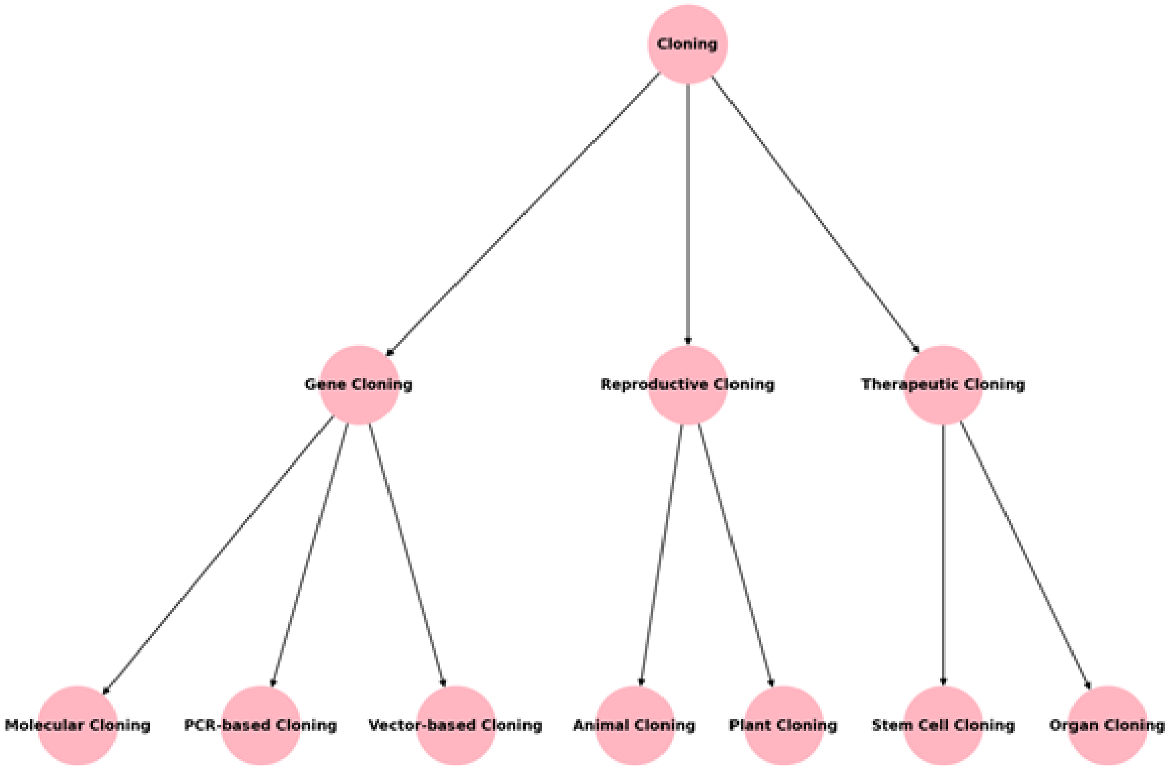

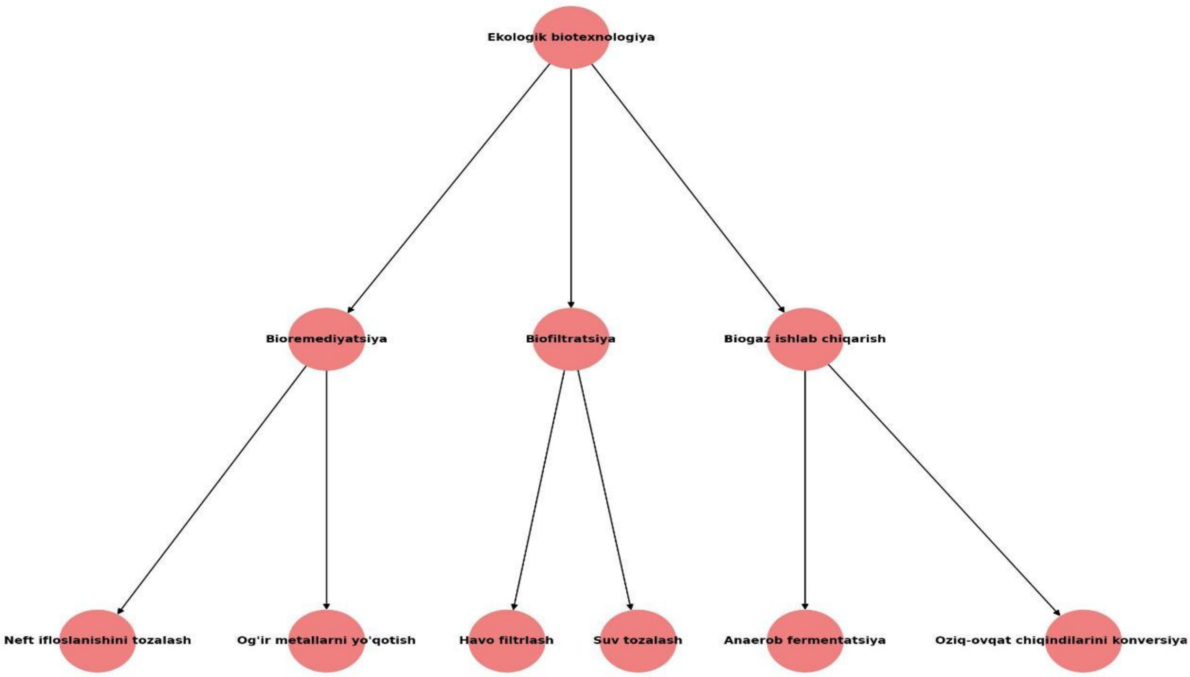

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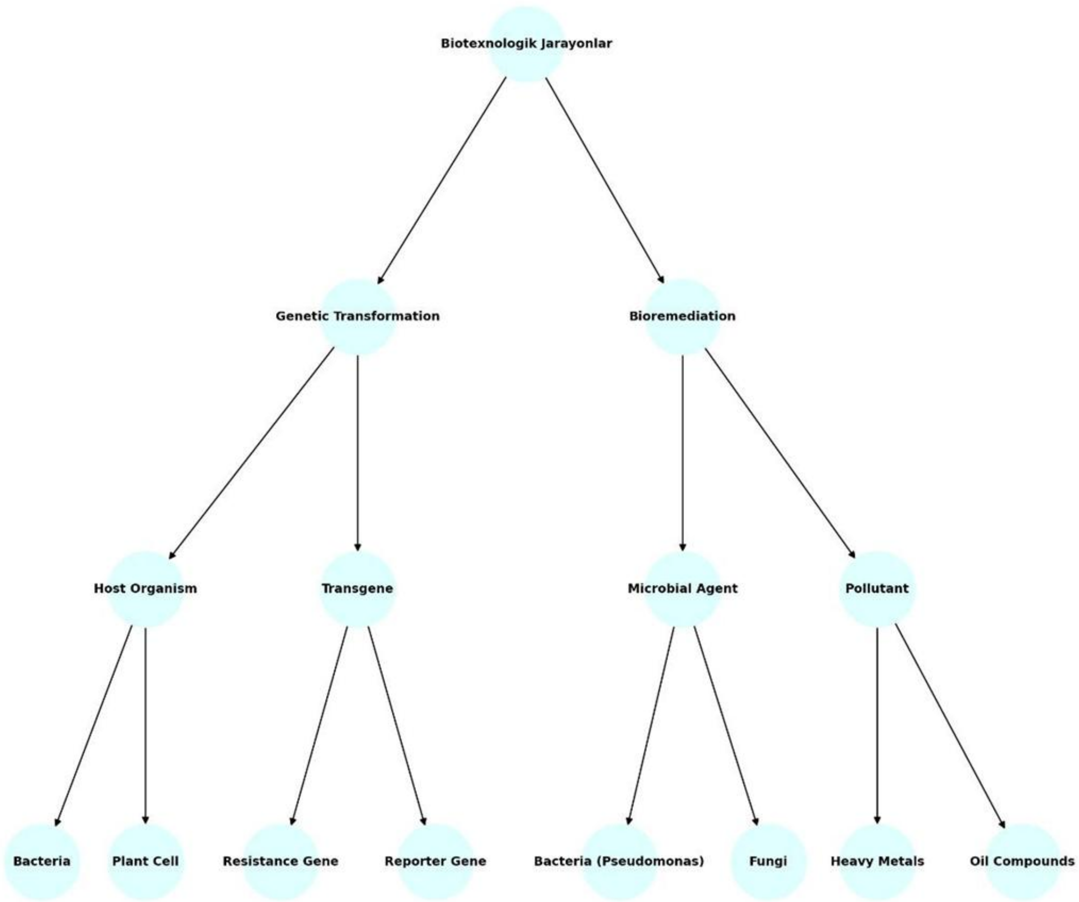

Discussion

The findings highlight the systematicity and internal logic of biotechnology terminology, which relies on hierarchical semantic relations to organize vast bodies of scientific information. The use of hyper-hyponymic structures across multiple levels supports clarity, precision, and consistency in scientific communication. By comparing English and Uzbek terms, the study also uncovers cross-linguistic patterns and structural parallels, which are valuable for bilingual terminology development and translation practices.

Furthermore, the identification of intersecting taxonomies—where a single term may serve as both a subordinate and a superordinate—demonstrates the dynamic and flexible nature of scientific language. This flexibility ensures that

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terminology remains responsive to evolving knowledge and interdisciplinary integration.

Conclusion

The study of hyper-hyponymic relations in biotechnology terminology reveals the depth and complexity of semantic hierarchies within specialized language. These paradigmatic relationships—ranging from general–specific concepts to process–object, parameter–carrier, and property–object models—highlight the systematic and multidimensional nature of terminological organization in the field. By examining examples in both English and Uzbek, this research has shown how semantic subordination helps not only to classify and structure knowledge but also to facilitate precise scientific communication across disciplines. Ultimately, these semantic structures are vital for advancing both terminological clarity and interdisciplinary understanding, forming a solid foundation for translation, lexicographic work, and cross-cultural scientific collaboration.

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