

Analysis of Knowledge Points and Test Points Related to "Temperature" in Senior High School Biology

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Abstract: This study focuses on the 'temperature' related knowledge points in high school biology, employing literature analysis and summarization methods. It systematically reviews the requirements for 'temperature' content as outlined in the 'Ordinary High School Biology Curriculum Standards.' By analyzing real questions from the past decade's biology college entrance exams, it identifies the high-frequency test points related to 'temperature,' revealing the characteristics and trends of ability assessments in temperature-related questions. The results indicate that 'temperature' related questions account for approximately 10% to 15% of the total biology exam questions, with a score range of 8 to 12 points. The specific ratio and score can vary based on the difficulty of the questions and the distribution of test points. The study emphasizes the application of real-world scenarios, with question types including multiple-choice, fill-in-the-blank, experimental design, and comprehensive analysis. Key test points include cellular respiration and enzyme activity, body temperature regulation and homeostasis maintenance, the role of temperature factors in ecosystems, and experimental design and investigative skills. This research provides a theoretical basis for optimizing teaching strategies and fostering students' core competencies.

Keywords: Temperature; College Entrance Examination Proposition; Core Literacy

As global climate change intensifies, the impact of temperature on biodiversity, agricultural production, and human health is

becoming increasingly evident. The ecological crisis is deepening, and the construction of ecological civilization has become an urgent requirement for the development of modern civilized society. High school biology, as a key medium for cultivating students' scientific and ecological awareness, can enhance their environmental consciousness and sense of responsibility by deeply analyzing and exploring knowledge related to 'temperature' in teaching. Therefore, the educational value and social significance of biological knowledge about 'temperature' are becoming increasingly important. The 'General Senior High School Biology Curriculum Standards (2017 Edition 2020 Revision)' (hereinafter referred to as the 'New Curriculum Standards') serves as a guide for teaching [1]. By organizing the relevant knowledge points about 'temperature' in the curriculum standards, we can gain a clearer understanding of the relationship between temperature and life, grasp the logical structure of high school biology textbooks more comprehensively, and understand the concepts of matter and energy, evolution and adaptation, and homeostasis and balance more objectively. Moreover, knowledge related to 'temperature' is not only a crucial foundation for understanding life phenomena but also an important link connecting molecules and cells, heredity and evolution, homeostasis and balance, biology and the environment, and biotechnology and engineering.

1. The Requirements of the New Curriculum Standards for Knowledge and Content Related to "Temperature"

Regarding temperature-related content, the New Curriculum Standards clearly require students to analyze the impact of non-biological factors (including temperature)

on life activities. In the 'Molecules and Cells' module, students need to explore how temperature affects enzyme activity: enzyme activity is regulated by temperature, peaking at the optimal temperature, while high or low temperatures can reduce enzyme activity. High temperatures can damage the spatial structure of enzymes, leading to permanent inactivation. Additionally, students should understand how temperature influences cellular respiration, which is essentially a series of enzymatic reactions. Within a suitable temperature range, as the temperature rises, the activity of respiratory enzymes increases, and the rate of cellular respiration accelerates. However, once the optimal temperature is exceeded, enzyme activity decreases, and the rate of respiration slows down. When temperatures are too high, respiratory enzymes denature and become inactive, leading to the cessation of cellular respiration. As an important metabolic activity of cells, photosynthesis requires students to understand how temperature affects it. Temperature not only influences the activity of enzymes involved in photosynthesis but also impacts the absorption and conversion of light energy during the photosynthetic process. In the 'Genetics and Evolution' module, students should understand how temperature factors influence biological evolution and variation. From an evolutionary perspective, temperature, as an environmental factor, plays a role in natural selection. Different organisms adapt to different temperature environments, with those better adapted surviving more easily, thus promoting biological evolution. From a variation perspective, temperature affects the frequency of gene mutations, and extreme temperatures can affect the stability of DNA molecules, making errors more likely during replication and increasing the likelihood of genetic variations.

In the "Homeostasis and Balance" module, students will learn about the role of temperature in the human body's internal environment and homeostasis. The human body maintains a relatively stable body temperature through neuro-humoral regulation, which is crucial for maintaining the stability of the internal environment and affecting bodily functions. In the "Biology and Environment" module, students will analyze how temperature impacts populations and ecosystems. Temperature is a critical environmental factor

influencing the distribution of organisms, population dynamics, and community structure. Temperature changes not only affect the reproduction, growth, and development rates of organisms but also influence population size, thereby driving community development and change. In the "Biotechnology and Engineering" module, students will understand how temperature affects key steps in fermentation and cell engineering. Different microorganisms have optimal growth temperatures, which significantly impact their growth and metabolism. In genetic engineering, the activity of certain enzymes is also influenced by temperature. Additionally, the "New Curriculum Standards" emphasize experimental inquiry, including designing temperature gradient experiments to study changes in respiratory rate or photosynthesis, designing experiments to investigate the effects of temperature on enzyme activity, and exploring the relationship between plant hormone regulation and temperature, all aimed at developing students' scientific thinking and experimental analysis skills.

2. Analysis of the High Frequency Test Points Related to "Temperature" in the Real Questions of The College Entrance Examination In Recent Ten Years

Through a detailed analysis of the biology college entrance examination questions over the past decade, it has been found that questions related to 'temperature' cover multiple types, including multiple-choice, fill-in-the-blank, experimental design, and comprehensive analysis. These questions make up a significant portion of the exam, with a relatively stable frequency, accounting for about 10% to 15% of the total questions, and are worth 8 to 12 points. The specific proportion and value of these questions can vary based on the overall difficulty and distribution of exam points each year. These questions not only require students to understand how temperature affects biological molecular structures, cellular physiology, genetic evolution, population dynamics, and ecosystem functions but also emphasize their ability to precisely control temperature variables in experimental settings, design control experiments, and analyze changes in experimental results caused by temperature factors. Additionally, they stress the importance

of integrating knowledge from various modules. Therefore, during the preparation process, students need to reinforce their foundational theories, enhance their experimental thinking, build a comprehensive knowledge system, and be flexible in handling the diverse and changing question formats in the college entrance examination. Through summarization and analysis, it has been found that questions related to 'temperature' mainly focus on the following four aspects:

2.1 Cellular Respiration and Enzyme Activity

Cellular respiration is a vital physiological process for organisms to obtain energy, with enzymes playing a crucial role in catalyzing this process. Temperature, as a key environmental factor affecting cellular respiration and enzyme activity, is a critical topic in high school biology education and exams. Additionally, the experiment 'Investigating the Conditions of Temperature on Enzyme Activity' is an important experiment in the People's Education Press high school biology curriculum. The teaching objective of this experiment is to help students summarize the patterns of how temperature affects enzyme activity [2]. Therefore, a deep understanding of the relationship between temperature and cellular respiration, as well as enzyme activity, is essential for students to grasp the principles of biological metabolism. By analyzing high school exam questions over the past decade, four key areas can be identified: how temperature influences enzyme activity to regulate cellular respiration rate, the relationship between temperature and enzyme activity, the analysis of respiratory stages, and the interpretation of respiratory rate curves and related experimental design.

2.2 Temperature Regulation and Homeostasis Maintenance

Body temperature regulation is a core mechanism for maintaining the stability of the internal environment in living organisms and is a key component of the regulation of life activities tested in the college entrance examination. Over time, different organisms have developed unique body temperature regulation strategies, which accurately reflect their adaptive features to the environment. In the interaction between organisms and their

environment, body temperature regulation is closely linked to maintaining a stable internal balance. To understand body temperature regulation, students should focus on the following key points: the differences in temperature regulation mechanisms between warm-blooded and cold-blooded animals, the neuro-humoral mechanisms of body temperature regulation, the balance between heat production and dissipation, adaptive responses to changes in environmental temperature, and the identification of common misconceptions.

2.3 The Role of Ecosystem and Temperature Factors

Temperature, as one of the key abiotic factors in ecosystems, directly influences the physiological metabolism of individual organisms, population distribution, and the structure and function of entire communities. In the processes of energy flow and material cycling within ecosystems, temperature can act as a limiting factor for biological survival, while also promoting adaptive evolution among species. Based on trends in college entrance examination questions, the following four areas have become key focuses: the impact of temperature on biological physiological activities, the influence of temperature on species distribution, community changes, and energy flow within ecosystems, and the ecological adaptation and hazards of extreme temperatures.

2.4 Experimental Design and Exploration Ability

The 'New Curriculum Standards' emphasize the importance of enhancing and refining biology experimental teaching, aiming to ensure that students, after completing their high school biology studies, possess the core biological competencies necessary for personal lifelong development and societal progress. The standards state: "The biology curriculum is designed to enhance students 'core biological competencies.'" The fundamental concept is that the cultivation of these competencies is a basic requirement, scientific inquiry is an effective method to improve these competencies, and biology experimental teaching is the optimal approach to achieve this goal^[3]. Temperature, a critical environmental variable affecting life activities, is a core

component of high school biology experiments. In the assessment of experimental design and scientific exploration skills, temperature-related experiments not only test students' grasp of basic theories but also develop their ability to control experimental variables, independently analyze data, and solve problems. By analyzing past college entrance exam questions, four key areas have emerged: the mechanisms and experimental design of temperature effects on enzyme activity, the impact of temperature on cellular respiration and curve analysis, the combined effects of temperature on photosynthesis and respiration, and the optimization of temperature-related experimental designs and the identification of common errors.

In summary, the characteristics of biology questions in the college entrance examination often revolve around real-life scenarios, social hotspots, and the current state of biological survival under climate change. These questions integrate knowledge related to 'temperature,' emphasizing comprehensiveness and situational relevance. They require students to extract key information, analyze, and solve real-world biological problems. Looking ahead, questions on 'temperature' will increasingly focus on interdisciplinary integration, incorporating new research findings and technological advancements. This requires students to stay informed about the latest developments in their field and broaden their knowledge base. This research can provide theoretical guidance and practical references for high school biology teaching, enhancing teaching effectiveness, fostering students' environmental awareness and ecological literacy, and contributing to the improvement of biology education content and the innovation of teaching methods.

3. Summary

In summary, knowledge related to 'temperature' spans from the molecular level to the ecosystem, characterized by its broad scope, deep examination, and strong relevance to real-world scenarios. In college entrance examination questions, the assessment of 'temperature' knowledge is marked by a stable score ratio, diverse and comprehensive content,

and realistic context. In terms of breadth of knowledge, ability requirements, and relevance to reality, the importance of 'temperature' knowledge surpasses that of other non-biological factors. Its multidimensionality and comprehensiveness make it a key carrier for implementing the core competencies outlined in the New Curriculum Standards and reflecting the unity of biology and the environment. This study will help teachers accurately understand the requirements for 'temperature' knowledge in the New Curriculum Standards, providing a theoretical basis for enhancing teaching effectiveness and optimizing preparation strategies for this part of the knowledge. It also holds significant meaning for the deep integration of teaching and learning in biology in this area.

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