

# Construction of Teaching System for Developing Students' Core Literacy in Biology

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**Keywords:** Biology; Core Literacy; Teaching System Construction; Teaching Mode

**Abstract:** Developing students' core biological literacy is the core task of middle school biology curriculum. The concept of biology is the overall understanding of biology and life, and the foundation and pillar of the core literacy of biology. Based on the analysis of the conceptual system of biology and philosophy of life science, it is determined that biological concepts include the concept of biological essence and the concept of life. Among them, the concept of biological essence points to the understanding of biology; the concept of life points to the understanding of life, mainly including the material view, energy view, information view, evolutionary view, ecological view and system view of life. As an inquiry teaching mode based on Constructivism theory, 5E teaching mode can effectively enhance the learning effect and interest of natural science, and has been widely recognized by the international scientific education community. Effectively combining 5E teaching mode with core literacy of subjects and applying it to teaching practice is expected to promote the cultivation of students' core literacy of subjects and ultimately promote the formation and development of core literacy.

## 1. Introduction

With the continuous advancement of the core literacy education reform, the voice of the educational circles on how to land the core literacy has become more and more strong. However, classroom teaching is undoubtedly one of the most important ways for students to truly develop their core literacy [1-2]. So how can we know that our classroom teaching is implementing core literacy and its degree of implementation, which requires the intervention of classroom evaluation. Classroom evaluation is not only related to the quality and efficiency of classroom teaching, but also to the pace of curriculum reform [3-4]. Therefore, as an important part of the basic education curriculum system, biology should conform to the trend of educational development and seek early methods and techniques to effectively evaluate students' core literacy level of biology [5].

Literacy is inherent, which defines the goal of education from the perspective of human beings. Therefore, the study of biological concepts from the perspective of core literacy can not be regarded as static and objectified subject knowledge only from the perspective of discipline [6-7]. Instead, we should consider the needs of students' development, excavate the core of knowledge and deep educational value, guide students to understand the essence of life and biology, and lay a foundation for the formation of essential character and key ability. From the perspective of core literacy, this paper probes deeply into the connotation, value and content system of biological concepts, and puts forward some suggestions on the teaching of biological concepts.

## 2. The Connotation of Core Literacy in Biology

### 2.1 The Connotation and Educational Value of Biological Concept

Concept is an advanced form of objective things reflected in the human brain, the basis and core of scientific theory, and the most concrete principle guiding practice by theory. Ideas are different from concepts. First, concepts, as the product of Abstract thinking, often reflect the essential attributes of a class of things. Concepts are based on many concepts and sublimated to a more comprehensive, essential and profound understanding of things through Abstraction, reasoning and

other thinking processes [8]. As the highest form of knowledge, concept is in essence the form of full development of concept. From this point of view, concepts and the “general concepts” mentioned in foreign educational research have a great consistency, which reflects the general understanding of subject knowledge, methods and so on. Secondly, concepts generally answer the questions of “what” and “why” of the objective world, which is about the knowledge of the objective world. Ideas can also answer the question of how people “do” to the objective world, which is directly related to human social action and has a clear value orientation. Biological concepts are the distillation and sublimation of biological concepts and laws in people's minds [9]. They are people's overall understanding and understanding of the essence of life and the nature of biology. They can explain natural phenomena, understand natural laws and solve practical problems from a biological perspective.

Biological concepts have a lasting understanding, which is what students still have in their minds after they forget the facts of specific subjects. They are also called “information that can be taken home” and can be transferred and applied in complex real situations. Biological concept is teachable and learnable. The key to its formation is rational thinking such as analysis and synthesis, Abstraction and generalization. Moreover, the formation of biological concepts is a gradual process, with stages and lifelong. Through the study of middle school biology curriculum, students gradually enrich their understanding of the connotation of biological concepts, and eventually develop the habit of thinking from a biological perspective, forming their basic views and attitudes towards the life world [10-11]. The value of biological concepts is not to provide exact answers to various questions in the process of life, but to provide the direction of thinking for us to obtain answers, overcome the limitations of specific observations and experiments, and directly perspective the whole essence of life. Only through the nourishment of ideas can people who study and study life science form a unified understanding of knowledge in different levels and fields of life science. The construction of biological concepts is conducive to promoting students to form a scientific outlook on nature, the world and values. The content structure of Chinese students' development core quality is shown in Figure 1.

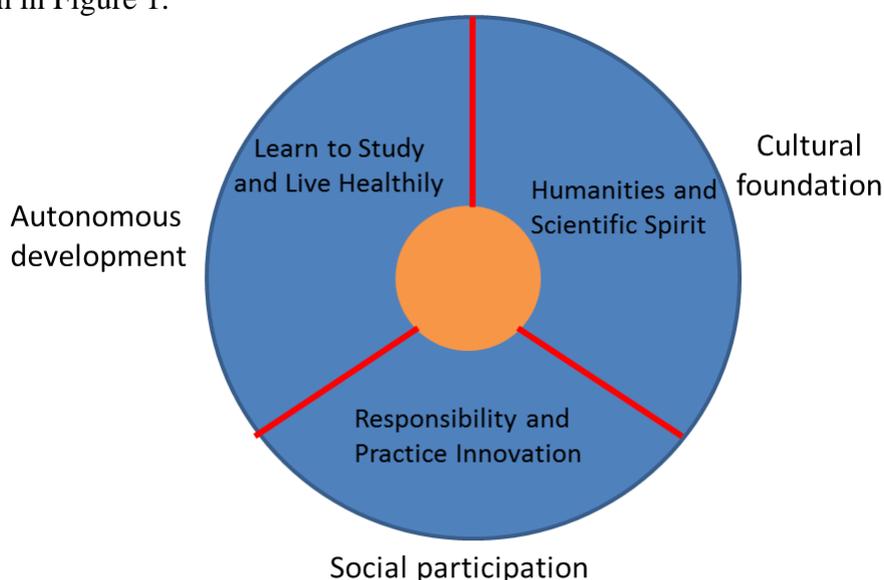


Figure 1 The content structure of the core quality of Chinese students' development

## 2.2 Basic Thoughts on Refining Biological Concepts

The current curriculum standards for biology in senior high schools and compulsory education in China do not systematically express the content system of biological concepts. Previous studies have rarely systematically combed biological concepts and defined the specific connotation of biological concepts [12]. Therefore, to carry out the concept-based teaching in the middle school biology curriculum, the first problem is to construct the content system of biological concept. The refinement of biological concepts from the perspective of core literacy should not only embody the

basis and key characteristics of core literacy, but also highlight the characteristics of disciplines. Specifically, the refinement of biological concepts should mainly consider the following aspects.

Firstly, we should regard the value and basic task of middle school biology curriculum in developing students' core literacy as the starting point and the end point of extracting biological concepts. Through the study of biology curriculum in middle school, on the one hand, students understand life on the basis of constructing concepts, so as to better understand the nature. On the other hand, we should take part in scientific inquiry and technical practice activities to establish a better understanding of biology, so as to better understand the nature of science and develop a good scientific attitude and spirit. Therefore, the Abstraction of biological concepts should focus on students' understanding of life and biology, paying attention not only to the concept of life, but also to the concept of the nature of science.

Secondly, the refinement of biological concepts should be based on the core concepts of disciplines. Biological concepts are not castles in the air, but are based on core concepts. Biology is a rich conceptual system. The core concepts of middle school biology curriculum mainly include cell, metabolism, homeostasis and regulation, heredity and variation, evolution and adaptation, ecosystem, biodiversity and so on. To understand the essence of life, students should first understand the above core concepts. Therefore, the Abstraction of biological concepts needs to establish the deep structure of biology based on the core concepts of biology. At the same time, because science is a whole and there are interrelationships and intersections among disciplines, there will inevitably be some general concepts, such as system, structure and function. These general concepts have a wide connection with biological concepts, which is conducive to students' better understanding of life, biology and science. Therefore, the refinement of biological concepts should also pay attention to scientific general concepts.

Finally, the Abstraction of biological concepts should also proceed from the perspective of philosophy of life science. Philosophy of life science is a philosophical discipline which studies the essence of life, the theory, thought and method of biology. The discussion of the status of biology in science, the social responsibility of biology, the essence and value of life by biophilosophers in history can provide reference for us to understand the essence of life and refine biological concepts.

### **3. The Role of 5E Teaching Model in Biology Core Literacy**

The concept of life refers to the Abstraction after explaining the observed phenomena of life and their interrelations or characteristics. It is the viewpoint of people after empirical research. It is the consciousness, concept and thought method that can understand or explain the biological related events and phenomena. The formation of "life concept" is based on a better understanding of the important concepts of biology. It is a scientific outlook on life, nature and the world formed by students after completing the biology course. It can help students to explore and solve practical problems related to biology.

The purpose of developing 5E teaching mode is to help learners construct scientific concepts. Many research cases have proved the effectiveness of 5E in achieving this goal, and found that it can significantly improve the learning effect of science courses and the retention time of scientific concepts. In addition, 5E model can effectively change students' preconceptions, and has been widely used in classroom teaching practice to discover erroneous concepts and conceptual changes. In teaching, teachers can make full use of the effective role of 5E teaching mode in the construction of scientific concepts to achieve the teaching objectives of students' understanding of important biological concepts, and "push the boat along the water", and then point out students to promote the formation of "life concept".

#### **3.1 Scientific inquiry**

5E teaching mode is a teaching mode that takes inquiry as the key link and takes inquiry as a main line throughout the whole process. "Scientific inquiry" requires students to discover biological problems in the real world, and to observe, ask questions, hypothesis, experiment design, program implementation, communication and discussion for specific biological phenomena. Some

researchers have shown clearly the corresponding relationship between 5E teaching mode and scientific inquiry in the form of graphics. According to Figure 2, it is not difficult to see that 5E teaching mode and scientific inquiry have a high degree of consistency in concept and implementation, and can effectively cultivate students' inquiry abilities in all aspects. Internationally, scholars have noticed that 5E teaching mode can effectively cultivate students' scientific inquiry. For our country's science education, 5E teaching model can be used as an important way to implement core biological literacy in the classroom.

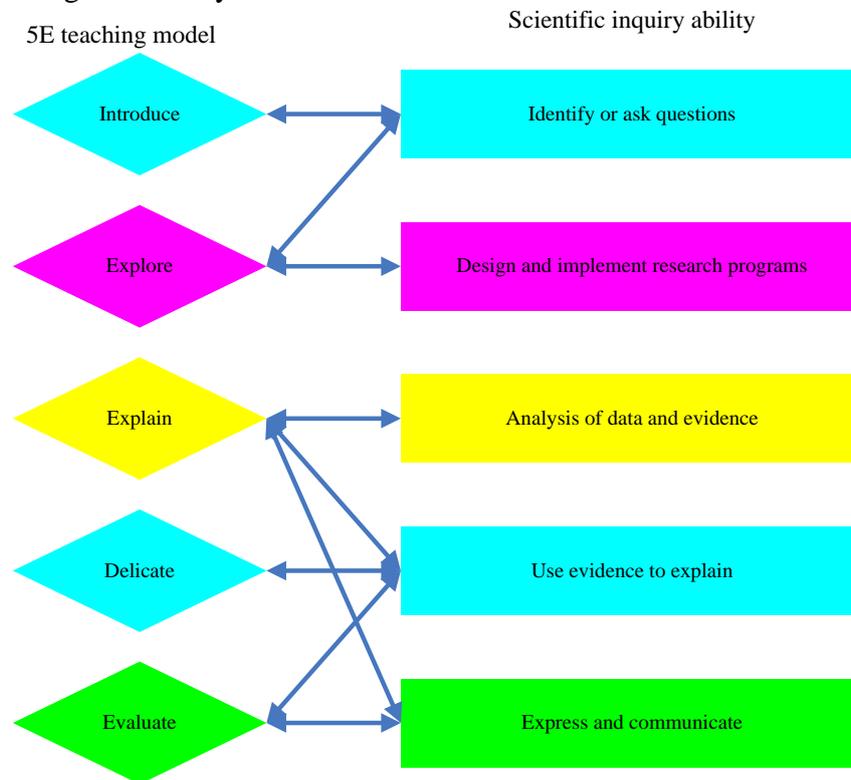


Figure 2 The corresponding diagram between 5E teaching model and scientific inquiry ability

### 3.2 Social responsibility

Social responsibility means that students can use biological knowledge, understanding and thinking methods to participate in the discussion of personal and social affairs, make rational explanations and judgments, and try to solve production and life problems after completing the biology course. Before discussing the cultivation of “social responsibility” as a core biological accomplishment in 5E teaching mode, it is necessary to briefly explain the relationship among four aspects of biological core accomplishment.

The four aspects of biological core literacy do not exist in isolation, but complement each other. The formation of the concept of life is based on students' better understanding of biological conceptual knowledge, which requires rational thinking and scientific inquiry. Rational thinking, as a scientific way of thinking, can enable students to effectively explore the phenomena and laws of life, examine and demonstrate social issues. Scientific inquiry is not only a way of thinking, but also a way of conducting scientific investigations. It is also a knowledge system, which can help students better understand the concept of life, and guide students to conduct scientific investigations and correctly fulfill their social responsibilities. The concept of life, rational thinking and scientific inquiry are the solid foundation of social responsibility. They can enable students to participate in the discussion of personal and social affairs, make rational explanations and judgments, and solve biological problems in life.

“Social responsibility” is a result of the gradual infiltration of students' thinking, value judgment and sense of responsibility through the study of biology curriculum, but not a specific teaching content. In fact, it is the result of extended learning after the formation of “life concept”, “rational thinking” and “scientific inquiry” literacy. It is also the goal of biology curriculum. At present, the

role of 5E teaching mode in helping students form social responsibility is only to see its indirect contribution. When students form a scientific concept of life and have the ability of rational thinking and scientific inquiry. In the face of personal affairs and social issues, they should be able to make scientific and rational decisions, reflecting their responsibilities.

### 3.3 The Corresponding Relationship between 5E Teaching Model and Biology Core Literacy

5E teaching mode has the function of promoting the formation of Biology Core literacy. It can cultivate all aspects of students' Biology Core literacy. The corresponding relationship between the two is shown in the form of diagrams. From the display of Figure 3, it can be seen that using 5E teaching mode in classroom teaching can help students form and develop their core biological literacy in many ways, achieve the requirements of biology curriculum objectives.

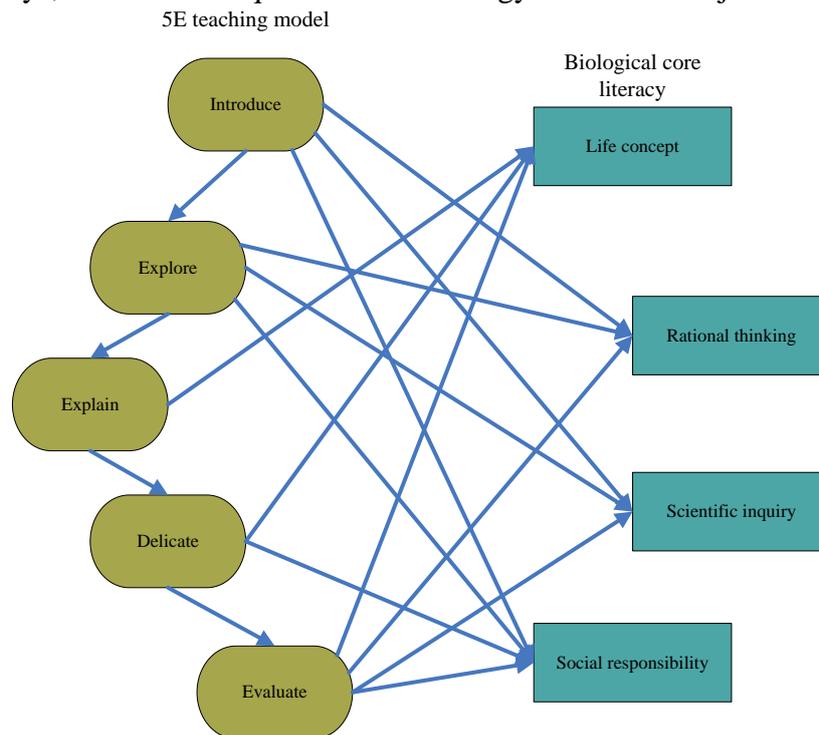


Figure 3 The relation diagram between 5E teaching model and biology core literacy

## 4. Conclusion

Core literacy-oriented classroom teaching is a brand-new subject and challenge faced by teachers and researchers from textbook compilation to front-line in curriculum reform and teaching practice in China, and there is no experience to follow. In order to achieve the goal of cultivating students' core literacy to the greatest extent and in the shortest time, it is suggested that teachers should take "core literacy" as the guiding ideology of teaching design. In the course preparation of biology unit and the design of each class hour, the teaching goal is "the core quality of the subject", and 5E teaching mode can be used as a way and template to realize the teaching intent, so as to carry out a positive attempt. It is believed that positive research results will bring positive results.

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