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Exploration of Teaching Postgraduate Course "Animal Cell and Immune Theory and Technology" Based on the Cultivation of Postgraduates' Innovation Ability

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Abstract: *The teaching of postgraduate course "Animal Cell and Immune Theory and Technology" has the characteristics of strong theoretical coherence, comprehensive knowledge, cutting-edge technology, and diverse teaching methods. We carefully design the teaching system and content for the postgraduate course "Animal Cell and Immune Theory and Technology". The teaching plan focuses on the cutting-edge theories, key technologies, and practical applications to ensure that postgraduates can comprehensively master the relevant immune knowledge and improve their innovation ability. During the teaching process, the case-based and practical teaching method, interactive teaching method, literature review, and some other teaching methods are adopted. In addition, the online resources are fully utilized for better teaching this course. By this way, the postgraduates can master the relevant theories and technologies, and they will understand the forefront and latest research progress in the field of animal cells and immunity. Their systematic scientific research thinking abilities can be exercised by these means.*

Keywords: *postgraduate; innovation ability; teaching method; teaching strategy; teaching exploration*

1. Introduction

For the postgraduate course "Animal Cell and Immune Theory and Technology", we carefully design the teaching system and teaching program based on the cutting-edge theories, key technologies, and practical applications in this field. In addition, we use the case and practical teaching method, interactive teaching method, literature exploration, and some other teaching methods in the teaching process. We also make full use of the online resources to teach the relevant theories and technologies in the field of animal cell and immunity. By this way, the students can fully grasp the relevant knowledge and improve their innovation ability.

2. Teaching system and content of postgraduate course "Animal Cell and Immune Theory and Technology"

2.1. Teaching system setting

The postgraduate course "Animal Cell and Immune Theory and Technology" includes the teaching of basic immunology, immune cell biology, immune molecular biology, immune sensors, tumor immunology, *etc*. The technologies involved in this course include the immune cell separation technology, immune detection technology (such as ELISA, flow cytometry, *etc*.), immunohistochemistry technology, gene editing and transgenic technology (such as CRISPR-Cas9), *etc*. For the teaching system of this course, we carefully design it based on the cutting-edge theories, key technologies, and practical applications in this field to ensure that students can fully grasp the relevant knowledge and improve their innovation ability. In addition, we use the authoritative cell biology and immunology textbooks and the latest research progress compilations from both domestic and foreign sources as teaching reference books. We also utilize the multimedia teaching resources such as images, animations, and videos to help students intuitively understand the complex immune processes and mechanisms of immunology. Thus the students can deeply understand the basic principles of the immune system, types and functions of immune cells, mechanisms of immune response, and pathogenesis of immune-related diseases. We also cultivate the

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students' experimental operation skills, data analysis and processing abilities, scientific thinking and innovation abilities, as well as the ability to solve complex biological problems.

2.2. Teaching content

In the teaching process of the postgraduate course "Animal Cell and Immune Theory and Technology", we focus on the application of immune cell culture technology, gene editing technology, artificial intelligence technology and other technologies in immunology. The immunocyte culture technology is an important means for the production of immunoglobulin, vaccines and other biological products. It plays an important role in the disease simulation, drug screening, and toxicology research. The immune cell culture technology can better simulate the environment of biological tissues, which is helpful for studying the pathogenesis of immune-related diseases *in vivo* and drug development. In addition, the gene editing tools such as CRISPR-Cas9 are increasingly being used in the study of immune-related disease mechanisms and genetic disease treatment. The artificial intelligence technology can be used for the large-scale biological data processing and analysis, which can predict the effect of drugs on protein structure in immune cells and the specificity of enzymes.

Moreover, we introduce the composition, function and basic principles of immune system in detail during the teaching process. We also analyze the latest research results in the fields of immune memory, vaccine development and immunotherapy. By integrating the practical immunological cases, such as the clinical trials of tumor vaccines and the successful application of immunotherapy, students can deepen their understanding and application of theoretical knowledge. In addition, some immune-related experiments are designed to let students observe the response of immune cells. Students are organized to discuss the application prospects and potential problems of cutting-edge progress. Through the combination of above teaching contents and methods, students can fully understand the basic knowledge, cutting-edge progress and application of animal cell and immune theory and technology. It will lay a solid foundation for the future scientific research work of students.

3. Characteristics of the teaching of postgraduate course "Animal Cell and Immune Theory and Technology"

The teaching of "Animal Cell and Immune Theory and Technology" has the characteristics of clear historical context, strong theoretical coherence, comprehensive knowledge, strong technical frontier, diverse teaching methods, and strong interaction. These characteristics help cultivate students' scientific literacy, innovative consciousness and practical ability. It will lay a solid foundation for their development in the field of animal cell and immunity. We fully explore these characteristics in the teaching process and apply them in the teaching process.

3.1. Organize the historical context of immunological theory and establish a systematic knowledge framework

In the teaching process, we start with teaching the origin and development of immunology. Through combing the important discoveries in various stages of immunology, such as the traditional immunology period, the modern immunology period, and the contemporary immunology period, we enable students to clearly grasp the overall context of the development of immunology. By combing the historical context of immunology, the immune theories of various periods are organically connected to form a coherent and systematic knowledge system. It helps students understand and grasp the core theories of immunology.

3.2. Emphasize the experimental and practical teaching of immunological theory

In the teaching process, we use multimedia and animation to tell important experiments in the history of immunology development, including antibody production experiments, immune tolerance experiments, *etc*. Thus, the students can experience the process and methods of immunology research and deepen their understanding of theoretical knowledge. In the classroom teaching, we further introduce the cutting-edge technologies in the current immunology research. It includes the gene editing technology, monoclonal antibody preparation technology, and immunohistochemistry technology, and their applications in the scientific research and practice. We guide students to pay attention to the application and development trends of these technologies in the field of animal cell and immunity. By this way, the students' innovative consciousness and practical ability can be cultivated.

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3.3. Guide students to pay attention to the transformation and application of immunological research results

In the teaching process, we introduce the application of immunology, such as the examples of its application in animal disease prevention and control, biological product development, medical diagnosis, tumor immunity, and other fields. By this way, the students can understand the practical significance and value of immunology research. We guide students to pay attention to the latest progress in the transformation and application of immunological research results. The students will understand how to transform basic research results into practical application technologies or products. Thus the students' awareness and ability to transform research results will be cultivated.

3.4. Diverse teaching methods, strong interaction, and timely use of bilingual teaching

To stimulate students' interest and effectively improve teaching effectiveness, we use the case and practical teaching methods, interactive teaching method, literature exploration, and some other teaching method in the teaching process. Students are encouraged to actively participate in classroom discussions and experimental operations and interact with teachers and other students. The students can share learning experiences and experiences and form a good learning atmosphere and team spirit.

Bilingual teaching aims to improve the students' English listening, speaking, reading and writing skills while learning the professional knowledge [1]. In teaching, we have clarified the teaching goal of "mainly imparting professional knowledge, supplemented by imparting professional English knowledge". At the same time, we gradually increase the use of English in the teaching process based on the difficulty of teaching content and English proficiency of students. We firstly explain the professional terms and concepts in Chinese, and then gradually explain and discuss in English. We also encourage students to ask questions and discuss in English in class, and cultivate their English listening and speaking skills.

4. Teaching of the intersection between "Animal Cell and Immune Theory and Technology" and other disciplines

As an interdisciplinary subject, immunology is closely related to some other disciplines such as molecular biology, cell biology, and genetics. We focus on the integration of interdisciplinary knowledge in the teaching process, so that students can understand and analyze immune phenomena and mechanisms from multiple perspectives. By comprehensively applying knowledge and methods from various disciplines to solve complex problems in the field of animal cells and immunity, the students' comprehensive thinking and problem-solving abilities will be cultivated.

During the lecture, the significance of interdisciplinary research is first introduced to students. We explain that the complex problems are often difficult to solve by using a single discipline, and the interdisciplinary research provides new perspectives and methods for scientific research in the modern scientific research. In addition, it will explain in detail which disciplines intersect with animal cell and immune theory and technology, such as the structural biology, cell biology, bioinformatics, molecular biology, and other disciplines. During the teaching course, we introduce how to use structural biology techniques (such as X-ray crystallography, cryo-electron microscopy, *etc*.) to analyze the three-dimensional structure of immune molecules and reveal their functions and mechanisms. We elaborate on the role of stem cells in the immune system and how immune cells affect the differentiation and function of stem cells. And, we illustrate the application prospects of stem cells in the immune reconstruction, autoimmune disease treatment, and other fields. In addition, we introduce how to use bioinformatics to analyze immunomics data and reveal the complexity and diversity of immune response. We further explain the application of biomedical engineering in immunological research, such as the construction of artificial immune systems and the simulation of immune microenvironments. Finally, we discuss the potential of these technologies in the disease treatment, tissue engineering, and other fields.

5. Adopt the flexible teaching methods and strategies to enhance students' learning enthusiasm

We make full use of multimedia and information technology in the teaching process. Moreover, we adopt the case and practice teaching method, interactive teaching method, literature exploration, and some other teaching methods. Through these teaching methods, students can deeply understand the practical application and significance of animal cell and immune theory. In addition, we design some experiments to allow students to observe various immune cells and immune responses first-hand. We

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also make full use of some online learning platforms, scientific research databases, and other resources to cultivate their innovative abilities and practical skills.

5.1. Case and practice teaching method

The case and practice teaching method of "Animal Cell and Immune Theory and Technology" has the advantages of combining theory with practice [2]. It can cultivate students' practical operation ability, promote teamwork and communication, and improve scientific literacy, which conforms to the modern educational concepts. In the case and practice teaching, we not only focus on cultivating students' professional skills, but also pay attention to improving their overall quality. By using the case and practical teaching methods, students can learn the theoretical knowledge of animal cells and immunology, and deepen their understanding and memory of theoretical knowledge.

We also share the latest research results, disease treatment cases or technological breakthroughs related to animal cells and immunity in the classroom. Thus the students can see the importance and application value of these theories and technologies in real life. Through video, animation or picture display, students can intuitively understand the practical application of these theories and technologies in the fields such as medicine, biotechnology, and agriculture. Through the case teaching, students can intuitively observe experimental phenomena, understand experimental principles, and enhance their understanding and memory of theoretical knowledge.

The case and practice teaching is usually more attractive than the pure theoretical teaching, which can stimulate students' interest and curiosity. We arrange some experiments related to animal cells and immunity, allowing students to conduct experimental operations by themselves. They can experience the fun of scientific research in the process of hands-on operation, and thus become more motivated to engage in learning. This "learning by doing" approach helps students transform abstract concepts into concrete operational processes, thereby better mastering relevant knowledge. Through the cell and immune-related experimental operations, students can master basic skills such as immune cell culture, immunization, and antibody detection, which will lay a solid foundation for their future research. During the experiment process, students need to communicate with each other, share experimental experience, and discuss experimental results. This communication not only helps to solve problems encountered in the experiment, but also promotes their friendship and trust among students. In addition, in the process of practice, students need to constantly try new methods and ideas to solve the problems they encounter. This kind of innovative training helps students to constantly innovate and make progress in their future research.

5.2. Interactive teaching method

The interactive teaching method refers to a holistic dynamic process in which the teacher is the leader and the student is the main body of studying [3]. It is guided by the heuristic teaching principle during the classroom teaching process. Two processes of teacher's "teaching" and student's "learning" interact, promote, and complement each other. This method emphasizes the influence of people and environment. Through the regulation of teacher-student relationships and their interactions, it creates a resonance in teaching and effectively improves teaching effectiveness. During the teaching process, we design a series of questions related to the course content to guide students to actively think and explore answers. Students are encouraged to ask questions and discuss them in class. Through group discussions, students can learn from each other, exchange ideas, and enhance the interactivity of learning.

The interactive teaching emphasizes students' enthusiasm, initiative, and creativity, allowing students to take the lead in their learning. The interactive communication fosters students' engagement and interest in learning. In addition, the interactive teaching is the problem-oriented. By asking questions, discussing problems and solving problems, students can find the answers of questions during the discussion process, thus better understanding and mastering knowledge. The interactive teaching can adopt various teaching methods, such as group discussion and role-playing. It allows students to learn in different teaching environments and improves their learning effectiveness and interest. By using the interactive teaching methods, teachers are no longer the traditional knowledge transmitters, but rather student-centered. This way can stimulate students' enthusiasm and interest in learning and guide students to learn independently.

5.3. Digital technology empowers curriculum teaching and learning

Relying on the school's intelligent teaching platform, we make full use of multimedia teaching

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methods such as courseware, video, animation, *etc*. In the teaching process, we present the complex theoretical knowledge in an intuitive and vivid way. We make full use of rich online learning resources such as online courses, scientific research papers, academic databases, *etc*. Moreover, we encourage students to use these resources for self-learning and in-depth research. Multimedia teaching combines various media forms such as images, sounds, and animations, which can vividly and visually demonstrate complex concepts and processes in immunology. For example, the process of immune response can be animated, including the presentation of antigen information by monocyte macrophages and dendritic cells, recognition, activation, proliferation, and differentiation of T and B lymphocytes to produce immune effector products. By this way, these processes that are otherwise difficult to observe become intuitive and easy to understand. This teaching method can deepen students' understanding of the problem and improve their learning enthusiasm. Multimedia-assisted teaching can also break the limitations of traditional teaching materials, and expand students' knowledge through rich online resources such as the latest research findings, experimental videos, and images. Teachers can update and supplement teaching content according to teaching needs, making teaching more in line with the frontiers of the discipline. In addition, multimedia teaching can reduce the time teachers spend on blackboard writing, greatly increasing the amount of information in classroom. At the same time, the usage of multimedia elements can shorten the time of students mastering knowledge, and significantly improve the efficiency and quality of teaching.

In addition, the smart teaching platform breaks the limitations of time and space, and it connects students and teachers through Internet technology. It can realize a new graduate smart teaching ecosystem that integrates online and offline learning. Students can choose their own learning time and location through online learning platforms, which improves their flexibility and autonomy in learning. Teachers can upload learning resources and teaching materials through online teaching platforms. They can engage in online communication and discussion with students and provide timely feedback on students' learning progress. It will help students improve their learning effectiveness. The usage of interactive teaching software allows students to engage in the real-time interactive discussions in classroom. It can promote the active thinking and communication among students and stimulate their interest and participation in learning. By this way, it will finally improve their academic ability and problem-solving skills.

5.4. Literature discussion teaching method

The literature exploration teaching method refers to the process in which teachers guide students to understand the development trends, research hotspots, and cutting-edge issues in the field of immunology by consulting relevant literature in the field. It deepens their understanding and mastery of subject knowledge through discussion, analysis, and summarization. This method emphasizes students' initiative and participation. Through the self-regulated learning and cooperative learning, the students' information literacy, critical thinking and innovation ability will be improved.

During the teaching process, we clarify the teaching objectives of literature review based on the curriculum requirements and the actual situation of students. It includes understanding the development trends of the discipline, mastering key theories and methods, cultivating information literacy and critical thinking, *etc*. Based on the teaching objectives and subject characteristics, we select the appropriate literature resources, including academic journals, dissertations, monographs, conference papers, technical reports, *etc*. During the literature discussion process, students are encouraged to personally review and analyze the literature to understand the latest research progress and cutting-edge issues, broadening their knowledge horizons and thinking space. During the process of literature review, students need to master certain skills in information retrieval, screening, sorting, and analysis, which helps to cultivate students' digital information literacy and self-learning ability.

In the teaching process, we assign reading tasks and require students to carefully read literature [4]. They can understand the main content and perspectives of literature, and prepare relevant questions and discussion points. After students have completed their literature reading, we organize them to engage in discussions and exchanges. Through the group discussions, whole-class discussions, and question-and-answer sessions, we guide students to delve into the issues and perspectives presented in literature, fostering intellectual stimulation and inspiration. After the discussion and exchange, the teacher guides students to summarize and reflect. We also ask them to summarize the main content and viewpoints of literature, analyze the advantages and disadvantages of literature and its application, and propose their own insights and reflections. Through the in-depth analysis and discussion of literature, students can learn to examine and analyze problems from different perspectives, which will improve their critical thinking and innovation ability.

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During the teaching process, teachers should ensure the quality of the selected literature and avoid selecting outdated literature [5]. Teachers should encourage students to actively participate in discussions and exchanges. The students should express their own views and opinions, and avoid the phenomenon of "one-sidedness" or "awkwardness". During discussion, teachers should also cultivate students' critical thinking, guiding them to examine the problem from multiple perspectives and analyze the nature and causes of problem. Finally, the time and progress of literature discussion should be reasonably arranged during the teaching process, which ensure students have enough time for literature reading, discussion, and communication. At the same time, it is necessary to make flexible adjustments according to the teaching progress and actual situation of students.

6. Conclusions

In summary, the teaching of postgraduate course "Animal Cell and Immune Theory and Technology" has the characteristics of strong theoretical coherence, comprehensive knowledge, strong technical frontier, diverse teaching methods, and strong interaction. We make full use of the multimedia and information technology in the teaching process, and we adopt the case and practice teaching method, interactive teaching method, literature discussion, and some other teaching methods. By this way, the students will understand the cutting-edge and latest research progress, and the students' systematic scientific research thinking ability will be exercised by these means.

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